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Kinematics of the chromospherically active binaries and evidence of an orbital period decrease in binary evolution

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ABSTRACT

Kinematics of 237 Chromospherically Active Binaries (CAB) were studied. The sample is heterogeneous with different orbits and physically different components from F to M spectral type main sequence stars to G and K giants and super giants. The computed U, V, W space velocities indicate the sample is also heterogeneous in the velocity space. That is, both kinematically younger and older systems exist among the non-evolved main sequence and the evolved binaries containing giants and sub giants. The kinematically young (0.95 Gyr) sub-sample (N=95), which is formed according to the kinematical criteria of moving groups, was compared to the rest (N=142) of the sample (3.86 Gyr) in order to investigate observational clues of the binary evolution. Comparing the orbital period histograms between the younger and older sub-samples, evidences were found supporting Demircan's (1999) finding that the CAB binaries lose mass (and angular momentum) and evolve towards shorter orbital periods. The evidence of mass loss is noticeable on the histograms of the total mass ($M_h + M_c$), which is compared between the younger (available only N=53 systems) and older sub-samples (available only N=66 systems). The orbital period decrease during binary evolution is found to be clearly indicated by the kinematical ages of 6.69, 5.19, and 3.02 Gyr which were found in the sub samples according to the period ranges of $logP \leq 0.8$, $0.8 < logP \leq 1.7$, and $1.7 < logP \leq 3$ among the binaries in the older sub sample.

Key words: stars: activity, stars: binaries spectroscopic, stars: chromospheres, stars: evolution, stars: kinematics

1 INTRODUCTION

Chromospherically Active Binaries (CAB) are the class of detached binary systems with spectral types later than F characterized by a strong chromospheric, transition region, and coronal activity. Enhanced emission cores of Ca II H and K, and sometimes in the Balmer H_α line are primary indicators of the chromospheric activity and often accompanied by photometric variability due to starspots. The first published catalog of CAB by Strassmeier et al. (1988) contained the classical RS CVn systems defined by Hall (1976) and the BY Draconis-type binaries defined by Bopp & Fekel (1977). The 168 CAB in the first catalog have been increased to 206 in the second catalog by Strassmeier et al. (1993). The third catalog has not yet been published but Eker privately continued to collect CAB. The unpublished list of Eker, which became the main database for this study, nowadays contains about 280 CAB.

At the first attempt, Eker (1992), was rather unsuccessful in breaking up the 146 CAB sample into kinematically distinct sub samples. Containing spectral types from F to M and luminosity classes from V to II, the already heterogeneous CAB sample was found to be heterogeneous also in the sense that the kinematically younger and older systems exist among the evolved binaries with at least one component of a giant or a sub giant, and among the un-evolved main sequence binaries. The Hipparcos data (Perryman et al. 1997) was not available to Eker (1992). However, Aslan et al. (1999), who used the Hipparcos proper motions and parallaxes of 178 CAB, also found no clues to non homogene-

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ity in the velocity dispersions. Aslan et al. (1999) concluded that there are not any significant differences between the sub samples of RS CVn binaries, although there are some indications of the main sequence RS CVn binaries having smaller velocity dispersions, indicating the smaller ages.

The increased number of the CAB sample with the greatly improved astrometric data (parallaxes and proper motions) of Hipparcos (Perryman et al. 1997) motivated us to restudy the kinematics of the CAB in a similar manner to Eker (1992). As soon as the U, V, W space velocities and the dispersions were produced, the (γ) shaped concentration in the velocity space near the location of the local standard of rest (LSR) on the (U, V) plane was immediately noticed. It was soon realized that the concentration was formed by young binaries belonging to the moving groups.

The Moving Groups (MG) are kinematically coherent groups of stars that share a common origin, and thus offer a better way of compiling sub samples of CAB with the same age. Eggen (1994) defined a supercluster as a group of stars gravitationally unbound but sharing the same kinematics occupying extended regions in the Galaxy. Therefore, a moving group, unlike the well known open clusters, can be observed all over the sky. Determination of the possible members of MG among the binaries and single stars was carried out by Eggen (1958a-b, 1989, 1995), Montes et al. (2001a) and King et al. (2003).

Consequently, the initial intention of studying the kinematics of the CAB sub samples like Eker (1992) was changed to break up the whole sample into two groups, where the first group contains the possible MG members chosen by the kinematical criteria originally defined by Eggen (1958a, b, 1989, 1995) and the rest of the sample. Picking up the possible MG members from the whole sample of CAB which are known to be young made it possible to form kinematically young and old sub samples. After studying the kinematics and determining the average ages, the histograms of the total mass ($M_h + M_c$), period, mass ratio and orbital eccentricity were compared between the two sub samples as much as the available data permits. This new system of investigation using kinematical data made it possible to discover new observational clues to the binary evolution confirming that the detached CAB also lose mass and angular momentum. The angular momentum loss and period decrease were predicted for the tidally locked short period systems (Demircan 1999). Apparently, the binary evolution with orbital angular momentum loss also exists among the unlocked long period systems. Due to the limited space, the investigation into the mass loss rates and associated rates of orbital period decrease will be handled in a forthcoming study.

2 DATA

The 237 systems were selected out of the 280 CAB in the unpublished list of Eker. The criteria of selection is the possession of complete basic data, (proper motion, parallax, and radial velocity) allowing computation of the space velocity of a binary system with respect to the Sun. The selected systems are listed in Table 1 with the columns indicating an order number, the most common name, HD and Hipparcos cross reference numbers, celestial coordinates (ICRS J2000.0), proper motion components, parallax and radial velocity. The basic data were displayed with associated standard errors. The reference numbers in the last column are separated into three fields with semicolons to indicate from where the basic data were taken. The two or more reference numbers in a field separated by commas indicate sub fields if there is more than one reference to any basic data.

2.1 Parallaxes and proper motions

The parallaxes and the proper motions in Table 1 were taken mainly from *The Hipparcos and Tycho Catalogs* (ESA 1997) and *The Tycho Reference Catalog* (Hog et al. 1998). Among the 237 systems in Table 1, only 15 (6.3%) binaries do not have Hipparcos parallaxes. Most of the Hipparcos parallaxes have relative errors much less than 50% ($\sigma_\pi/\pi << 0.5$). Only 14 systems (5.9%) in our list have $\sigma_\pi/\pi > 0.5$. Care was taken not to use parallaxes less than the two-sigma detection limit of Hipparcos which is 1.94 mas (σ=0.97 mas) (Perryman et al. 1997). It was therefore decided to discard the parallax measurement of five systems (IN Com, HD122767, RT CrB, V832 Her, AT Cap) and treat them as the other 15 binaries without a trigonometric parallax. However, the other nine systems with $\sigma_\pi/\pi > 0.5$ (V764 Cen, RV Lib, HD152178, V965 Sco, CG Cyg, RS Umi, RU Cnc, SS Cam, V1260 Ori) were kept in the main list since their parallaxes are bigger than the detection limit.

For the systems without trigonometric parallaxes, a published parallax of any kind was preferred. Among the 20 (15 with no π, five below the detection limit) only the six systems (HP Aur, HZ Com, HD71028, HD122767, V846 Her and V1430 Aql) were found without any published parallax so that the spectroscopic parallaxes were estimated for them from their spectral types and luminosity classes.

The Hipparcos and the Tycho catalogues usually supply an associated uncertainty for all of the measurements of the parallax and the proper motion components. However, there are six systems in the list without an uncertainty at the proper motion components. 'No errors quoted' may imply something odd about the star. One possibility is that no errors were there because none could be established. On the other hand, it could be a simple omission or too few data to permit a standard error estimation. With an optimistic approach, we have preferred to adopt the announced average uncertainties, which are 0.88 mas/yr in $\mu_\alpha cos\delta$ and 0.74 mas/yr in μ_δ, by Perryman et al. (1997) for the Hipparcos stars brighter than ninth magnitude. However, the uncertainty of 5.5 mas/yr in the proper motion components for HP Aur were taken from Nesterov et al. (1995). Similarly, 2.5 mas/yr uncertainty is taken from Bakos et al. (2002) for the systems ξ Uma B and CM Dra.

Nevertheless, the major contribution into the propagated errors for the U,V,W space velocities comes from the uncertainty of the parallax. Therefore, the largest errors must be associated with the nine systems (3.8% in the list) with $\sigma_\pi/\pi > 0.5$. In order to see their effect, an average propagated uncertainty of those nine systems were computed as $\delta U = \pm 7.16$, $\delta V = \pm 11.09$ and $\delta W = \pm 6.94$ km/s. However, there is a large intrinsic spread in the galactic space motions (U,V,W) that even such large uncertainties emposed by several individual motions appear to be unimportant. But still, for the sake of the statistical completeness, the miss-

ing standard errors of 15 spectroscopic parallaxes had to be completed.

Sparke & Gallagher (2000) state that if the interstellar absorption and the reddening do not introduce problems, the luminosities of the main-sequence stars can often be found to within 10%, leading to 5% uncertainties in their distance. The giant branch is almost vertical, thus the best hope for determining a luminosity is within 0.5 in the absolute magnitude, and hence the distance to 25%. Being in the safe side, the sub giants were assumed to be as giants, thus 25% uncertainty were assigned for the missing standard errors of eight giants and four sub giants. The missing standard errors of three systems (IM Vir, HP Aur, HZ Com) with dwarf components were assigned with a 5% uncertainty as Sparke & Gallagher (2000) suggest. With a median distance of 98 pc, the current CAB sample contains the nearby systems that the interstellar absorption and the reddening could be ignored. Moreover, the CAB are popular that they are usually well studied systems that we are confident to apply the rules of Sparke & Gallagher (2000) for estimating the missing standard errors of 15 (6.3% in the list) spectroscopic parallaxes. IM Vir and HZ Com are within 60 pc. Thus, with a 287 pc distance, only the error of HP Aur could be doubted. Nevertheless, It will not effect the statistics of the whole sample. The average propagated errors at U,V,W for these 15 systems were computed as $\delta U = \pm 5.49$, $\delta V = \pm 4.55$ and $\delta W = \pm 3.81$ km/s, which are smaller than the propagated errors of nine systems with $\sigma_\pi/\pi > 0.5$, but bigger than the average propagated errors of the whole sample : $\delta U = \pm 3.43$, $\delta V = \pm 2.92$ and $\delta W = \pm 2.42$ km/s.

Finally, after filling in the missing information in Table 1, the average standard errors on the proper motion components are 0.62 mas/yr in $\mu_\alpha cos\delta$ and 0.43 mas/yr in μ_δ and the average relative uncertainty of the parallaxes (σ_π/π) is 14.7%.

2.2 Radial velocities

Unlike the proper motions and the parallaxes, which were mostly taken from the Hipparcos and the Tycho Catalogs, the radial velocities were collected one by one from the literature. Moreover, unlike single stars with a single radial velocity, the binaries and the multiple systems require the radial velocity for the mass center of the system (γ). That is, numerous radial velocity measurements are needed just for computing the orbital parameters together with the velocity of the mass center of a system. Fortunately, the CAB are popular so that the reliable orbital parameters had already been determined for many systems. However, there are 21 systems in our list (Table 1) which are known to be binaries but do not yet possess determined orbital elements. For such systems, the mathematical mean of the measured radial velocities was adopted as the center of mass velocity and then the standard deviation from this mean was taken to be the error estimate. On the other hand, there are many systems with multiple orbit determinations. Nevertheless, most of the multiple orbit determinations are not independent. That is, the data used in the previous determination were also used or considered in the later study which gives the most improved orbital elements. In such cases, it was preferred to use the value of (γ) and its associated error from the most recently determined orbit unless the most recent study gives unexpectedly large associated errors. Rarely, there are systems with independently determined orbital parameters. For those, the weighted mean of the systemic velocities (γ) and the weighted mean of the associated errors were used. Those systems are listed with the multiple reference numbers separated by commas after the second semicolon in the last column of Table 1.

Different authors prefer to give different kinds of uncertainties associated with the published parameters of the orbit. In order to maintain consistency, the different types of uncertainties have been transformed into standard errors since most of our data are already expressed with the standard errors. Except for the probable error, the other uncertainties (mean error, standard error, rms error and σ) indicate the same confidence level. Therefore, they are transferred directly. However, when transforming the probable errors (PE) to the standard errors (SE), the relation of $PE = 0.675SE$ was used.

3 GALACTIC SPACE VELOCITY COMPONENTS

Galactic space velocity components (U, V, W) were computed together with their errors by applying the algorithm and the transformation matrices of Johnson & Soderblom (1987) to the basic data; celestial coordinates (α, δ), proper motion components (μ_α, μ_δ), radial velocity (γ) and the parallax (π) of each star in Table 1, where the epoch of J2000 coordinates were adopted as described in the International Celestial Reference System (ICRS) of the Hipparcos and the Tycho Catalogues. The transformation matrices use the notation of the right handed system. Therefore, U, V, W are the components of a velocity vector of a star with respect to the Sun, where U is directed toward the Galactic center ($l = 0^o, b = 0^o$); V is in the direction of the galactic rotation ($l = 90^o, b = 0^o$); and W is towards the north Galactic pole ($b = 90^o$). The computed uncertainties are quite small and the averages are $\delta U = \pm 3.43$, $\delta V = \pm 2.92$ and $\delta W = \pm 2.42$ km/s. By inspecting the space velocity vectors ($s = \sqrt{U^2 + V^2 + W^2}$), only 18 (7.6%) systems with the uncertainty of the space velocity bigger than ± 15 km/s were found. If those systems were removed from the sample, the average uncertainties of the components would reduce to $\delta U = \pm 2.4$, $\delta V = \pm 2.0$, and $\delta W = \pm 1.8$ km/s. Thus, most of our sample stars have uncertainties very much smaller than the dispersions calculated.

3.1 The space distribution

Before discussing the velocity dispersions and kinematical implications, it was decided to inspect the space distribution of the sample CAB. Therefore, the Sun centered rectangular galactic coordinates (X, Y, Z) corresponding to space velocity components (U, V, W) were calculated. The computed coordinates are given in Table 2. The projected positions on the galactic plane (X, Y plane) and on the plane perpendicular to it (X, Z plane) are displayed in Figure 1.

Fig. 1 indicates that, with a median distance of 98 pc, the current CAB sample contains relatively nearby systems, which can be considered as being contained within the galactic thin disk. They can also be accepted as almost homoge-

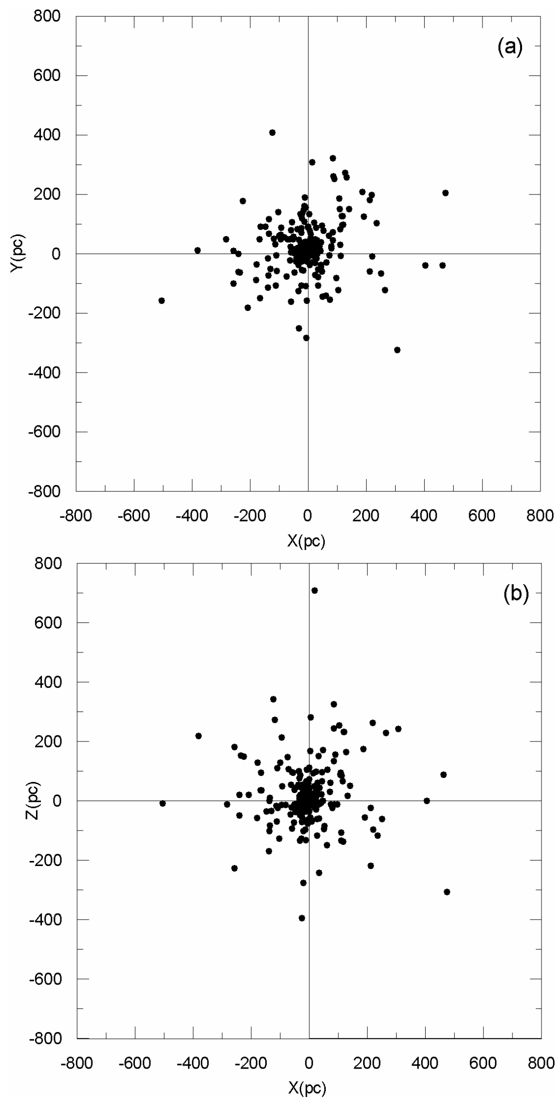

Figure 1. Space distribution of sample stars on galactic plane, and one other of two perpendicular planes. X, Y, and Z directed towards galactic center, galactic rotation and north galactic pole.

neously distributed in all directions as they are seen from the Sun.

3.2 Galactic differential rotation correction

The high accuracy of the U, V, W velocities motivated us to investigate the effect of the differential galactic rotation to the U, V, W velocities. The effect of the galactic differential rotation is proportional to the distance of stars from the Sun in the galactic plane, that is, the W velocities are not affected in the first approximation which assumes stars are on the galactic plane. Since all of the systems are relatively nearby, the first order correction described in Mihalas & Binney (1981) was announced to be smaller than the uncertainties of U and V by Eker (1992) for the 146 CAB which also exist in the present list. Nevertheless, there was no harm in applying the correction even if it is negligible, as Eker (1992) explained.

Since the largest uncertainty of the input data appears to be with the parallax measurements, the uncertainty of the distance contributes the most to the uncertainties of the U, V, W velocities when compared to the contributions of proper motions and radial velocities. With the greatly improved astrometric data of Hipparcos which produces reliable parallax measurements up to 500 pc, the uncertainties in the (U, V, W) space motions are greatly reduced (nearly five times) compared to the data used by Eker (1992).

Using the space distribution in X, Y plane in Fig. 1, the first order galactic differential correction contributions to the U and V space motions were computed as described in Mihalas & Binney (1981). Then, star by star, they were compared to the uncertainties of the U and V computed. It was not unexpected to see 128 stars (54%) in our list with the effect of galactic differential rotation being bigger than the uncertainty of U component of the space velocity. The effect on the V component is rather small, therefore, there are only three CAB with the effect being bigger than the uncertainty of V. Nevertheless, it seems evident that the first order galactic differential rotation correction is necessary for most of the stars in our sample. Therefore, the first order correction of galactic differential rotation was applied to all of the stars in the present sample. The corrected U, V, W are given in Table 2, together with the propagated standard errors.

3.3 Thick disc and halo binaries

The number of metal poor binaries in our sample was also determined by using the kinematical parameter $f = (1/300)(u^2 + 2.5v^2 + 3.5w^2)^{1/2}$ suggested by Grenon (1987) and Bartkevicius et al. (1999). Here, the u, v, w velocities represent a space velocity with respect to the LSR. The (u, v, w) velocities are obtained by adding the velocity of the Sun with respect to the LSR to the (U, V, W) velocities of stars with respect to the Sun. The values of $(U, V, W)_\odot = (9, 12, 7)$ km/s (Mihalas & Binney 1981) were used in this transformation. Statistically, the stars with $f \leq 0.35$ belong to the thin disc, the stars with $0.35 < f \leq 1.00$ belong to the thick disc. The stars with $f > 1$ belong to the halo. Consequently, the vast majority (92%) of our sample are thin disc stars. The thick disk stars are less composing about 7% of CAB in our sample. Only one binary star, HD149414 is a halo star according to its space motions (kinematically). The spectroscopic metal abundance ($[m/H] = -1.40$ dex) of this star given by Latham et al. (1988) confirms the classification based on the kinematical criteria. The Hipparcos parallax of this star gives the distance of 48 pc, so it appears to be a halo binary in the solar neighborhood. This binary has a long period (133 days) and a eccentric orbit (Mayor & Turon 1982). It is interesting that Buser, Rong, & Karaali (1999), and Siegel et al. (2002) found that the 6% of the solar neighborhood stars belong to the thick disc population, which is an almost identical ratio to our CAB sample.

4 DISCUSSION

4.1 General outlook

The distribution of the corrected U, V, W velocities on the (U, V) and (W, V) planes are displayed in Fig. 2. At first glance, the general look of the current (U, V) diagram (Fig. 2a) appears to have similar characteristics to the (U, V) diagram of Eker (1992) of the same sample but fewer stars (146) with much lower accuracy. Quantitatively speaking, the average motion of the current sample with respect to the Sun is $(U, V, W) = (-13.5, -19.7, -8.1)$ km/s having the dispersion of (37.3, 26.0, 19.4) km/s with respect to the LSR, which are indeed close to the values of Eker (1992): $(U, V, W) = (-10, -20, -7)$ km/s and the dispersions of (37, 27, 23) km/s. Later, Aslan et al. (1999) also studied the kinematics of the 178 CAB using the Hipparcos astrometric data. The shape and the distribution characteristics of the (U, V) diagram of Aslan et al. (1999) also has a similar appearance to the mean motion of $(U, V, W) = (-11.8, -20.5, -6.4)$ km/s relative to the Sun and $(35.8, 22.4, 18.2)$ km/s dispersions in the space velocities with respect to LSR.

The similar appearance, the similar mean velocity and the similar distribution of the current sample on the (U, V) does not seem to display any advantage of increased accuracy and increased number over the previous studies. However, as soon as our first (U, V) diagram was produced, the γ shaped concentration of (U, V) velocities near the LSR (See Fig. 2a) was noticed. Such a concentration of kinematically young systems is not noted by neither Eker (1992) nor Aslan et al. (1999). However, the γ shaped concentration is very clear in Fig. 2a. The concentration of the young systems is also noticeable on the (W, V) plane (Fig. 2b) but in a rather spherical shape.

Containing stars from F to M spectral types on the main sequence, together with the evolved G and K giants and even with the super giants, the studied samples of CAB happens to be very heterogeneous. On the other hand, the orbital periods of the binaries in the sample range from fractions of a day to more than 300 days. This may mean that there are different evolutionary paths (Plavec 1968; Thomas 1977) indicating different ages existing together among the sample stars. As Eker (1992) investigated and Aslan et al. (1999) announced, there could be no significant kinematical differences between the sub-samples of the CAB except some indication of the main sequence RS CVn systems tending to have smaller velocity dispersions implying smaller ages.

The difficulty of separating kinematically young and old populations in the velocity space alone is obvious. The dispersions increase with age but there are always some stars left near the LSR. It is therefore not safe to pick stars randomly near the LSR and then to form a kinematically young group with them. The classical approach would be to form the sub groups according to certain objective criteria at first, then to investigate and to compare the dispersions among the sub groups.

However, the concentration of velocities around $(U, V) = (17, -8)$, $(U, V) = (-4, -26)$, $(U, V) = (-37, -14)$, and $(U, V) = (0, 0)$ km/s perhaps reflect some kinds of group motions of the stars in the solar vicinity. Eggen (1958a-b, 1989, 1995) and Montes et al. (2001a) discuss the possible moving groups (Local Association, Ursa Major, Castor, IC 2391, and Hyades), which might cause the concentration of

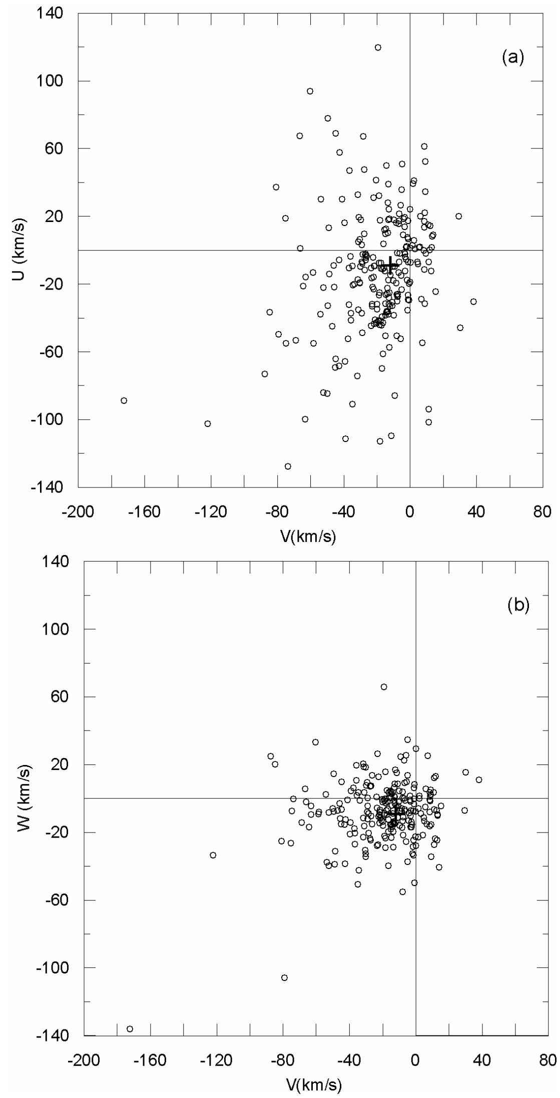

Figure 2. Velocity dispersions of CAB sample (a) on U, V plane, (b) on W, V plane. The velocities are heliocentric. The position of LSR is marked by +.

space velocities as described above. Therefore, as a first step before examining the classical sub groups, it was decided to determine the MG members of our sample and then investigate if the γ shaped concentration is caused by them. Moreover, the membership of one of the known MG would be an objective criterion to discriminate the kinematically young population of the present CAB sample.

4.2 Members of MG among CAB

The kinematical criteria originally defined by Eggen (1958a, b, 1989, 1995) for determining the possible members of the best documented moving groups are summarized by Montes et al. (2001a,b). Basically, there are two criteria:

(i) The proper motion criterion, which uses the ratio (τ/ν) as a measure of how the star turns away from the

converging point, where the ν and the τ are the orthogonal components of the proper motion (μ) of a test star. The component ν is directed towards the converging point and the τ is perpendicular to it on the plane of the sky. A test star becomes a possible member if $(\tau/\nu) < (0.1/sin\lambda)$, where the λ is the angle corresponding to the arc between the test star and the converging point.

(ii) The radial velocity criterion, which compares the observed radial velocity (γ, the center of mass velocity) of the test star to the predicted mean radial velocity $V_p = V_T cos\lambda$, where V_T is the magnitude of the space velocity vector representing the MG as a whole. The test star is a possible member if the difference between γ and V_p is less than the dispersions of the radial velocities among the stars in the MG.

Fulfilling one of the criteria makes the test star a possible member. Fulfilling both criteria, however, does not guarantee the membership. This is because there is always a possibility that the same velocity space is occupied by the MG members and the non members. Further independent criteria implying a common origin and same age as the member stars may be investigated in order to confirm the true membership.

The parameters of the five best documented MG and the possible membership criteria of each of them have been summarized in Table 3. The criteria have been applied one by one to all stars in our CAB sample and 95 systems out of 237 were found to be satisfying at least one of the criteria for one of the MG in Table 3. Those potential candidates are marked on Table 2 indicating the number of criteria fulfilled (1 means only one criterion, 2 means both criteria were satisfied) and the name of the MG involved. Some already known members are also marked on a separate column for a consistency check

After all of the possible MG members were determined, the sample was divided into two groups. The one which contains the possible MG members is called 'MG' and, the other, which contains the rest of the sample is named 'field stars'. The (U, V) diagram of these groups are compared in Fig. 3. The γ shaped concentration which was noticed on the (U, V) diagram of the whole sample (Fig. 2a) shows itself more clearly in Fig. 3a after the removal of stars which fail to be a possible member of any of the five MG in Table 3. The smooth distribution (Fig. 3b) with a larger dispersion of the field stars is also clear on the comparison with the whole sample (Fig. 2a) and the possible MG members (Fig. 3a). Comparison of these two groups on the (W, V) diagram are displayed in Fig. 4.

The kinematical differences between the two groups of CAB can be shown numerically if their mean motions and dispersions are compared. The 'MG' has a mean motion of $(U, V, W) = (-16.9, -13.5, -7.6)$ km/s with the dispersions of (20.6, 9.8, 12.8) km/s while the 'field stars' appear with a mean motion of $(U, V, W) = (-11.2, -24.0, -8.4)$ km/s and the dispersions of (45.4, 32.9, 22.9) km/s. According to Wielen (1977), $\sigma_U = 20.81$, $\sigma_V = 9.76$, $\sigma_W = 12.74$ km/s velocity dispersions indicate a kinematical age of 950 Myr, which is slightly bigger than the known ages of the MG given in Table 3. This is because the dispersion of stars was computed with respect to the LSR. However, true age would be less if the true dispersion point of each group is considered. Considering the fact that some of the possible moving group members are not really members, this age can be treated an upper limit. On the other hand, the kinematical criteria to form the 'MG' group chooses only a limited number of young binaries, there can be binaries left in the 'field stars' younger than 950 Myr. Thus, this age (950 Myr) cannot be considered as a lower limit for the 'field stars' which are found to have 3.86 Gyr age from the dispersions. There can be stars much younger and older than this average age among the 'field stars'.

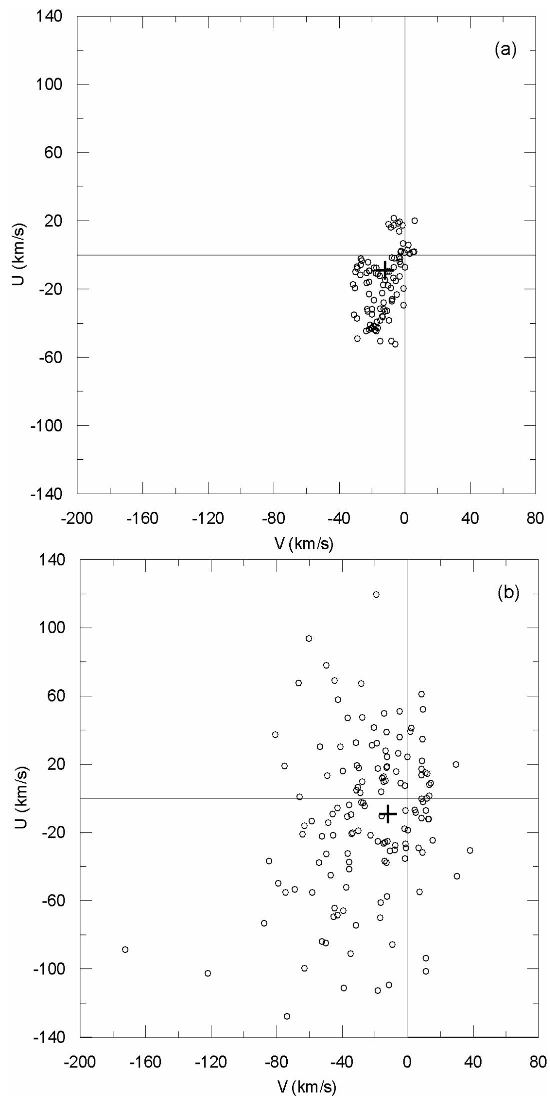

Figure 3. Distribution of (a) possible MG members and (b) field stars on the (U, V) diagram.

On careful inspection of Fig. 3b and Fig. 4b, one may notice the distinct holes left in the centers of the distributions after the possible MG members removed. This confirms the fact implied by the term 'possible', and suggests a substantial amount of the MG stars are really not MG members. Any individual systems being older than the common age of the MG could be selected out as non-members with the ages predicted by the stellar evolution, but this process too does

Table 3. Parameters of best documented moving groups and possible membership criteria.

Name	Age (Myr)	(U, V, W) (km/s)	V_T (km/s)	C.P. (α^h, δ^o)	$Sin\lambda(\tau/\nu)$	$\gamma - V_p$ (km/s)
Local Association (Pleiades, a Per, M34, δ Lyr, NGC 2516, IC2602)	20 – 150	(-11.6,-21.0,-11.4)	26.5	(5.98,-35.15)	<0.2	<5.5
IC 2391 Supercluster (IC 2391)	35 – 55	(-20.6,-15.7,-9.1)	27.4	(5.82,-12.44)	<0.1	<7
Castor MG	200	(-10.7,-8.0,-9.7)	16.5	(4.75,-18.44)	<0.1	<8
Ursa Major Group (Sirius Supercluster)	300	(14.9,1.0,-10.7)	18.4	(20.55,-38.10)	<0.1	<8
Hyades Supercluster (Hyades, Praesepe)	600	(-39.7,-17.7,-2.4)	43.5	(6.40,6.50)	<0.1	<10

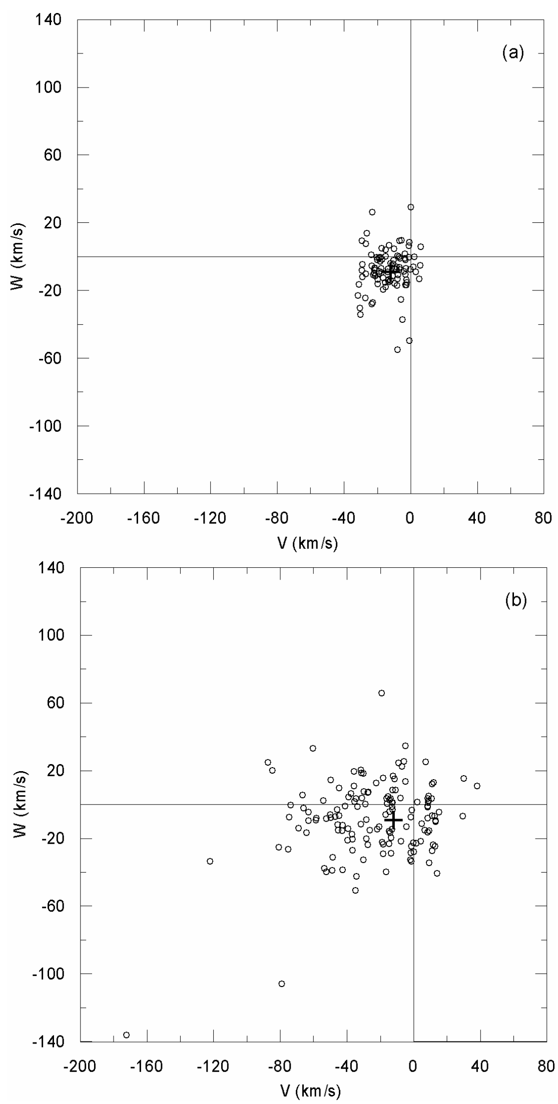

Figure 4. Distribution of (a) possible MG members and (b) field stars on the (W, V) diagram.

not guarantee to remove all of the non-members since there is still a possibility that a field star, with a similar age as the MG, occupies the same velocity space fulfilling the kinematical criteria to be a possible member. Nevertheless, our prime concern is to divide current CAB sample into two distinct age groups in order to compare the physical parameters then investigate the reasons behind if there is any noticeable difference. Although, both the 'MG' and 'field stars' are not very homogeneous to represent two different ages, we found current grouping satisfactory for this study.

4.3 Comparing 'field stars' and 'MG'

The physical parameters of the chromospherically active binaries are listed in Table 4. The columns are self explanatory and indicate the spectral type, SB (indicating single or double lined binary or whether within a multiple system), orbital period, eccentricity, mass ratio, mass of the primary, mass function, and radii of components. The data were collected primarily from the same literature where the radial velocities were taken.

Intending to compile binaries according to known evolutionary stages of luminosity classification, the whole sample has been divided into three groups. The first group is called 'G' which contains binaries with at least one component being a giant. A giant classification in the spectral type, if it exists, or otherwise, one of the radii being six solar radii or bigger, were accepted as criteria to form the 'G' group. The group of the sub giants 'SG' were formed from the rest of the sample with a similar criteria; a sub giant classification in the spectral type, or at least one component being bigger than two solar radii. After forming the giants and sub giants, the rest of the sample is called main sequence symbolized with 'MS'. All three groups contain almost equal numbers of 'MG' and 'field stars'.

In the first step, the mass and period distributions among those three groups were studied. The result confirms common knowledge that the massive systems are likely to be found in the group of the 'G' and the less massive systems are likely to be found among the 'MS' group, so it is not displayed. However, it is of interest to display the period distribution (Fig. 5) among the G, SG, and MS systems. The 'SG' group shows nearly a normal distribution with the peak at six days and a range of orbital periods from 0.79 to 50 days. The group of 'G' prefers not only more massive systems but also the systems with the longest orbital periods.

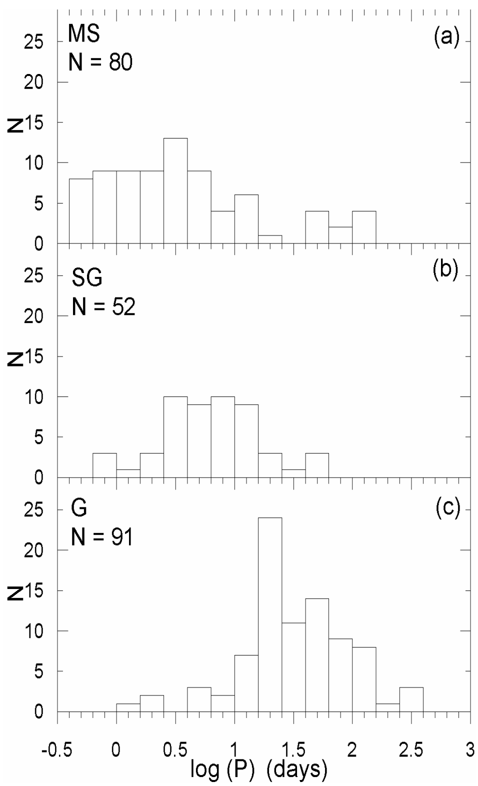

Figure 5. Histogram of period distribution among binary systems containing MS (main sequence), SG (sub giant), and giant (G). All groups contain almost equal numbers of younger 'MG' and older field binaries.

According to Fig. 5, systems containing a giant star prefer an orbital period of 10 days or longer, but rarely shorter periods. Notice the sharp decrease of the short period binaries in the 'G' group. The 'MS' systems are mostly less than 10 days down to the shortest period of 0.476533 days. Our sample does not have many shorter periods because CAB are detached systems. Much shorter periods are common among the contact (W UMa) and semi contact (β Lyrea) binaries. It is interesting to note that the range of 'MS' periods covers quite a range of the most preferred 'G' group periods with a smooth decrease. This decrease may well be due to the selection effect that main sequence long period systems are harder to be noticed than the long period binaries with a giant or two. However, similar selection effect cannot be true for the decrease of the 'G' systems towards the shorter periods.

Fig. 6 compares the orbital period distributions between the kinematically younger (MG) and older (field) populations in our sample. Both groups have about the same range of orbital periods. However, the younger MG group shows a rather smoother distribution, without a distinct peak, contrasting with the older population, which shows a peak of a gaussian at 11.3 ($logP = 1.053$) days. At first, the composition rates of G, SG, and MS systems in both groups were investigated. There are 88 systems in the younger population in Fig. 6a which is composed of 34% G, 24% SG, and 42% MS systems. On the other hand, there are 127 of the stars in the older population in Fig. 6b which is composed of 43% of G, 25% of SG, and 32% of MS systems. There is not much difference in the distributions of the subgroups between the two groups. Therefore, the period preferences of the sub groups (G, SG, and MS) alone cannot not explain the displayed difference between Fig. 6a and Fig. 6b. Nevertheless, the decrease in the number of systems in the longer and shorter periods in field stars (the older sample) may be an effect in the binary evolution.

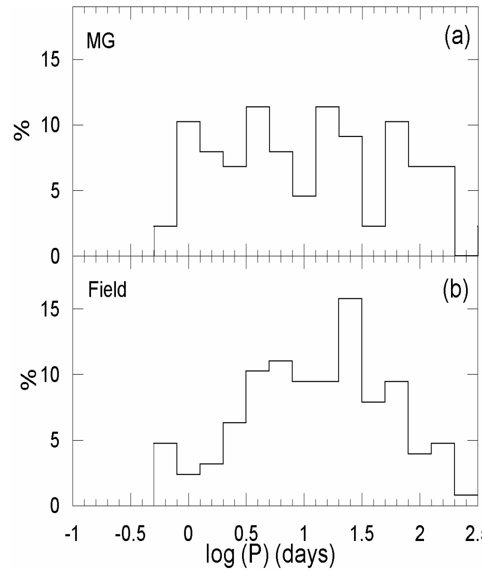

Figure 6. Comparison of period histograms of (a) MG and (b) field stars.

According to Demircan (1999), mass loss from a binary is associated with the momentum loss causing the decrease of the semi-major axis of the orbit. A shrinking orbit forces the orbital period to decrease. Fig. 6 appears to support this scenario. This is because, assuming that the 'field stars' have a similar period distribution as 'MG' at the origin when they were younger, the number decrease of longer period systems could be interpreted with the above prediction. However, the number decrease of short period systems appears to contradict the scenario. That is, normally one expects to count more systems with shorter periods among the older binaries if orbital periods decrease during evolution. However, it should not be forgotten that the binaries in our sample are all detached systems. Apparently, the period decrease and radius increase in the evolution changed those short period systems into contact or semi contact form, thus they are no longer in our sample and we see their number decreased relative to the original population. Therefore, the number decrease of the short period systems in Fig. 6b also supports the prediction of period decrease in the binary evolution.

By comparing the period histograms of the G, SG, and MS systems between the MG and the field stars, Fig. 7 also presents evidence of decreasing orbital periods during the binary evolution. It is noticeable that the histogram of G systems for the field stars shows a sharp peak at 20 ($logP = 1.3$) days. There is a sharper decrease towards the shorter periods. Such a sharp decrease is not visible in the young population (G systems of MG). This sharp decrease could be

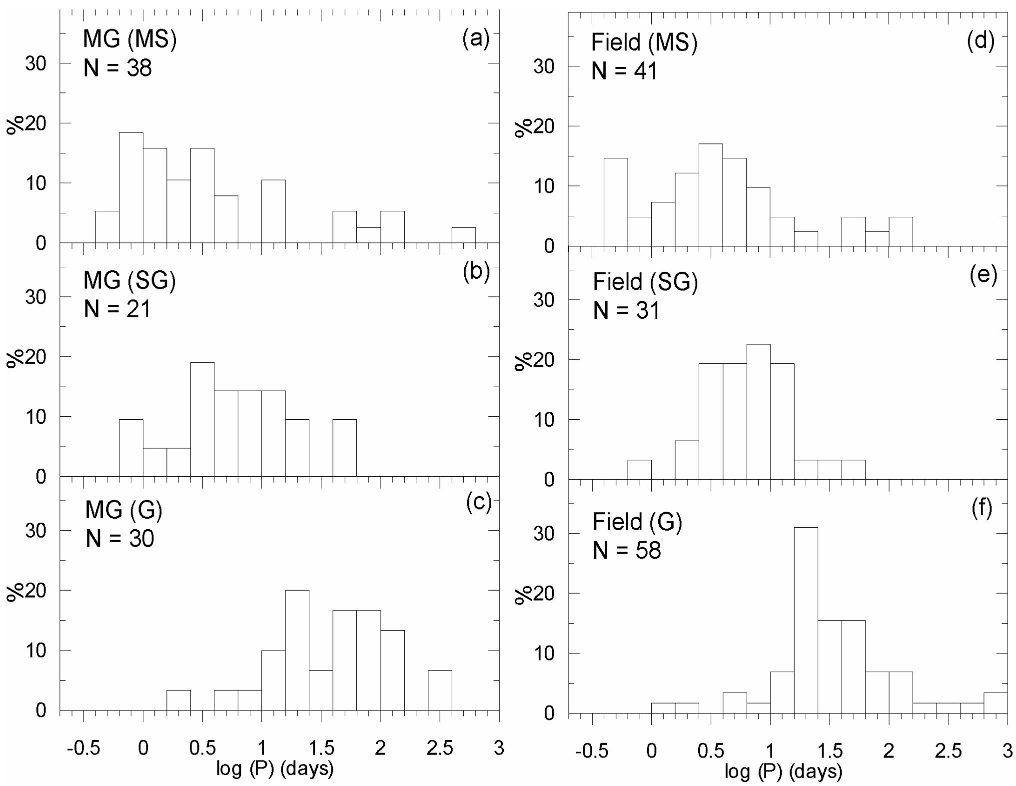

Figure 7. Comparison of period histograms of sub groups between MG and field binaries. (G) at least one component is giant, (SG) sub giant, and (MS) both components on the main sequence.

caused by the missing systems which are no longer on the list; due to evolution they became contact or semi contact systems. The shifting of the peak of the normal distribution towards the shorter periods as an evidence of the orbital period decrease is clearly visible in the comparison of the G groups; perhaps among the SG. Nevertheless, the opposite, that is, the peak of the distribution of f,eld (MS) systems appears to be at longer periods with respect to the peak of the MG (MS) systems. However, considering the fact that evolving into contact, or semi-contact configuration is most likely among the short period MS systems rather than G systems, therefore it could be normal to see the peak moving towards the longer periods in the statistics of the MS systems. The MS systems causing a peak at around the one day period in the MG group must have evolved to contact or semi contact configurations so that the number of such systems appears to be less in the field stars. Therefore, the peak appears to have moved towards the longer periods for field (MS) binaries.

One may ask why the peak of field (MS) binaries indicates a shorter period than the peak of field (G) binaries if evolution to contact configuration is effective for up to 10 days, which is indicated by the histogram of the field (G) binaries. Here, we must remember that neither the younger (MG) nor the older (field) group are very homogeneous. There could be older binaries among the possible MG members, so they are called possible, and there could be many young binaries among the field stars. The kinematical criteria only select possible MG members. It is possible that unselected stars could be young systems but not satisfy the MG criteria. This complication, however, is not to such a degree that despite this heterogeneous nature, the period shortening effect of the binary evolution is perceptible on our histograms. It is a challenge for future studies to select the older systems from the possible MG members and select the younger systems from the field stars for a better comparison of the younger and the older groups of binaries.

Table 5. Kinematical ages of period sub groups in field stars.

$log(P)$ (days)	N	σ_{tot} (km/s)	Age (Gyr)
(0.0 – 0.8]	48	61.38	6.69
(0.8 – 1.7]	59	53.15	5.19
(1.7 – 3.0]	23	40.99	3.02

Orbital periods decreasing with age are confirmed by the kinematical data. The older population (field stars) has been divided into three period ranges (Table 5) and the space velocity dispersions and kinematical ages were calculated for the short ($logP \leq 0.8$), intermediate ($0.8 < logP \leq 1.7$) and the long period ($1.7 < logP \leq 3.0$) systems. The increase of the dispersions, implying older ages, towards the shorter periods appears to support the period histograms, that is, the orbital period decrease must be occurring during the binary evolution.

The period decrease due to angular momentum loss requires that the total mass of the binaries must be decreasing

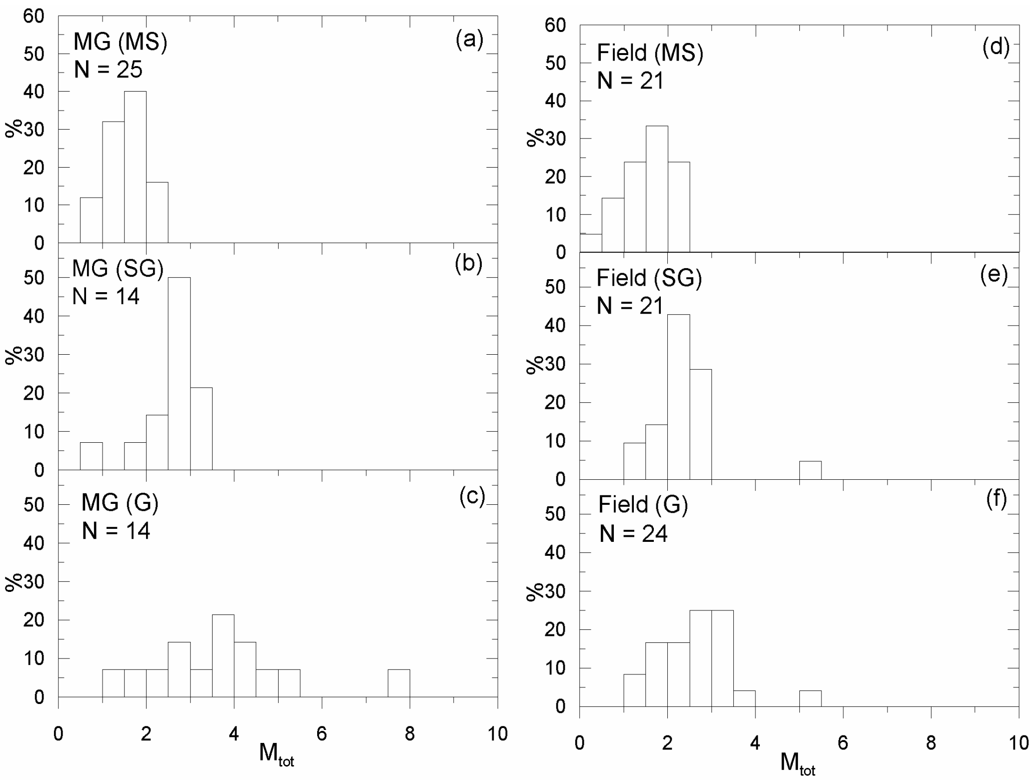

Figure 9. Comparison of total mass histograms of sub groups. (G) at least one component is giant, (SG) sub giant, and (MS) both components on the main sequence.

through the magnetically driven winds in CAB components (Demircan 1999). The distribution of binaries with respect to total masses (M_h+M_c) in MG and field binaries are compared in Fig. 8. The expectation was to be able to see the peak of the older group shifting towards the smaller values with respect to the peak of the younger group. However, the opposite is presented in Fig. 8. Contrary to the peak points, the tails of the histograms support the prediction of the total mass decrease of binaries. Indeed, the gradual decrease of the tail for the stars changed to a sharper decrease in the field stars towards the massive systems. That is, the big mass systems in the young population changed to smaller mass systems in the older population. Similarly, sharp number decrease of the younger population (MG) towards the less massive systems changed to a rather gradual decrease in the older population (field stars). Both indicates mass decrease in the binary evolution. However, the heterogeneity and the evolution into contact or semi contact configuration complicates the histograms, making the interpretation of the peaks more difficult. Therefore, the young and old groups of Fig. 8 are separated to compare the G, SG, and MS systems in Fig. 9. The decrease of the total mass, and therefore the shifting of the peak of the distribution towards the smaller masses, became noticeable in the comparisons of the G and SG systems but not very clear in MS systems. However, it may be interesting to note that the low mass tail of the MS systems of field stars is longer compare to the tail of MS systems of MG.

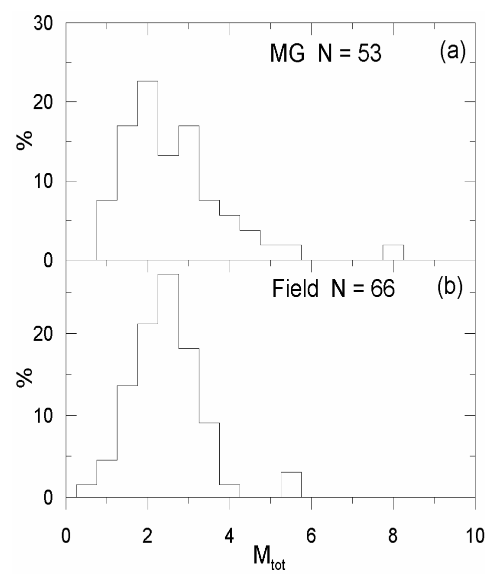

Figure 8. Comparison of the total mass (M_h+M_c) histograms of (a) MG and (b) field stars.

Fig. 10 compares the eccentricity histograms of the MG and the field stars. The field stars have a slightly higher peak at $e=0$ (circular orbits) but high eccentricity orbits exist at a similar level in both of the populations. The circularization of binary orbits are expected to be faster at shorter period

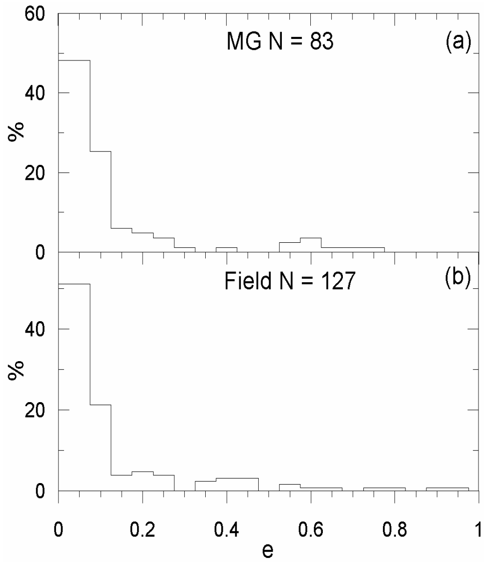

Figure 10. Comparison of eccentricity histograms between MG and field binaries.

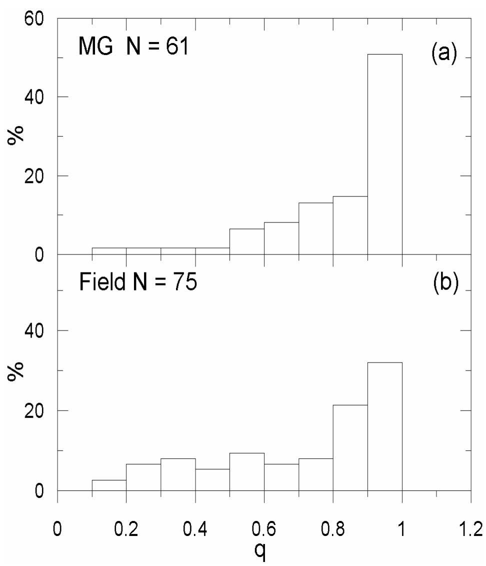

Figure 11. Comparison of mass ratio ($q = M_2/M_1$, where M_1 is primary and $M_2 < M_1$) histograms between MG and field binaries.

orbits. Since both groups contain long period orbits, it is normal to see eccentric orbits in both groups. However, it is interesting to see a decrease in the relative number for the slightly eccentric orbits ($e \sim 0.1$) in the field stars.

In order to compare the mass ratio between MG and field binaries, the mass ratio histograms in Fig. 11 were produced. The mass ratio $q = M_2/M_1$, where M_1 is primary and $M_2 < M_1$, is defined for Fig. 11. The difference is clear, in that the peak at $q = 1$ decreased and the number of low mass ratio binaries increased among the field stars. This is expected because during the binary evolution the mass ratio of $q = 1$ must decrease towards the smaller values. Because of the problems defining the mass ratio (M_2/M_1 or M_h/M_c) and the changing role and temperature of the components during binary evolution (a hotter component in the MS may become cooler as it evolves to sub giant and giant), the interpretation of Fig. 11 is not easy. Therefore, only the possible decreasing of the mass ratio through the evolution from MG to field binaries is pointed out here.

5 ACKNOWLEDGMENTS

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Table 1. Hipparcos astrometric and radial velocity data of the Chromospherically Active Binaries.

ID	Name	HD	HIP	$\alpha(2000)$ (h m s)	$\delta(2000)$ (^{o} $'$ $''$)	$\mu_\alpha cos\delta$ (mas/yr)		μ_δ (mas/yr)		π (mas)		γ (km/s)		References
1	BC Psc	28	443	00 05 20.14	-05 42 27.43	-8.29	1.64	88.19	0.52	25.38	1.05	-6.56	0.23	(1;1;103)
2	BD+45 4408	38		00 05 41.21	+45 48 35.34	885.60	4.70	-207.00	4.75	88.60	2.30	-8.73	20.10	(1;2;13)
3	5Cet	352	664	00 08 12.10	-02 26 51.76	7.25	1.29	-4.87	0.59	3.25	0.96	-0.43	0.27	(1;1;27)
4	LN Peg		999	00 12 30.31	+14 33 48.68	321.76	1.91	-71.31	0.96	24.69	1.20	-15.30	0.30	(1;1;74)
5	BD Cet	1833	1792	00 22 46.33	-09 13 51.09	3.60	1.27	-47.49	0.83	2.40	1.17	-4.80	0.30	(1;1;18)
6	13 Cet	3196	2762	00 35 14.88	-03 35 34.25	407.68	1.31	-36.47	0.61	47.51	1.15	10.37	0.40	(1;1;122)
7	BK Psc		3121	00 39 42.17	+10 39 13.68	525.30	1.93	-198.69	1.07	30.52	1.79	-10.95	0.32	(1;1;78)
8	FF And		3362	00 42 48.25	+35 32 55.62	264.99	1.95	74.49	1.22	42.03	1.98	-0.47	0.90	(1;1;36)
9	zeta And	4502	3693	00 47 20.33	+24 16 01.84	-101.23	0.68	-81.89	0.52	17.98	0.83	-24.43	0.11	(1;1;74)
10	CF Tuc	5303	4157	00 53 07.77	-74 39 05.62	243.00	0.75	20.20	0.64	11.60	0.65	0.50	1.60	(1;1;18)
11	eta And	5516	4463	00 57 12.40	+23 25 03.53	-43.72	0.67	-46.06	0.33	13.44	0.75	-10.30	0.29	(1;1;142)
12	BE Psc	6286	5007	01 04 07.15	+26 35 13.32	-10.96	2.31	-12.12	1.02	4.64	2.05	-19.72	5.68	(1;1;104)
13	CS Cet	6628	5227	01 06 49.03	-22 51 21.23	-39.53	1.03	-81.99	0.56	7.56	1.08	18.38	0.59	(1;1;163)
14	AI Phe	6980	5438	01 09 34.19	-46 15 56.09	54.50	0.92	-0.17	0.81	3.90	1.17	-1.84	0.06	(1;1;16)
15	YR 20	7205	5684	01 13 06.08	+41 39 15.49	314.65	0.64	-37.54	0.51	22.36	0.79	70.35	8.49	(1;1;76)
16	AY Cet	7672	5951	01 16 36.29	-02 30 01.33	-100.62	0.72	-63.95	0.41	12.74	0.72	-30.11	0.08	(1;1;63)
17	UV Psc	7700	5980	01 16 55.12	+06 48 42.12	84.84	1.22	19.23	0.82	15.87	1.32	6.45	0.40	(1;1;102,138)
18	BC Phe	8435	6408	01 22 18.98	-56 43 53.22	-12.15	0.84	-32.69	0.82	8.49	0.96	4.10	1.60	(1;1;18)
19	BI Cet	8358	6448	01 22 50.30	+00 42 43.39	-114.11	1.04	-239.36	0.57	15.21	0.96	-82.80	1.80	(1;1;33)
20	AR Psc	8357	6454	01 22 56.76	+07 25 09.34	94.39	1.03	230.73	0.58	22.13	0.99	18.17	0.07	(1;1;60)
21	BF Psc	9313	7134	01 31 54.86	+16 02 49.05	3.78	0.98	-147.69	3.46	9.81	1.01	-14.84	0.11	(1;1;79)
22	BB Scl	9770	7372	01 35 01.01	-29 54 37.20	85.56	2.65	96.58	0.85	42.29	1.47	34.20	2.00	(1;1;56)
23	UV For	10909	8281	01 46 41.65	-24 00 50.30	151.03	1.01	97.42	0.69	7.67	1.10	8.76	0.06	(1;1;61)
24	XX Tri	12545	9630	02 03 47.11	+35 35 28.65	-53.43	1.13	-15.74	0.87	5.08	1.10	-26.35	0.18	(1;1;156)
25	TZ Tri	13480	10280	02 12 22.28	+30 18 11.04	-64.59	0.96	-61.07	0.77	10.68	0.92	19.98	0.74	(1;1;112)
26	BQ Hyi	14643	10722	02 18 00.84	-71 28 02.76	18.64	1.21	16.67	1.06	4.67	1.11	4.00	0.70	(1;1;18)
27	CC Eri	16157	11964	02 34 22.57	-43 47 46.87	57.89	0.84	-293.63	0.69	86.87	0.86	41.94	1.50	(1;1;55)
28	UX For	17084	12716	02 43 25.57	-37 55 42.53	78.86	0.67	-73.06	0.64	24.77	0.80	20.30	0.70	(1;1;162)
29	VY Ari	17433	13118	02 48 43.72	+31 06 54.69	212.44	0.89	-174.20	0.73	22.73	0.89	-2.80	0.35	(1;1;39)
30	EP Eri	17925	13402	02 52 32.13	-12 46 10.97	398.10	0.84	-189.54	0.64	96.33	0.77	18.80	2.10	(1;1;26)
31	EL Eri	19754	14763	03 10 38.52	-05 23 38.07	54.77	4.04	3.35	1.92	4.56	1.76	13.70	0.60	(1;1;18)
32	LX Per		15003	03 13 22.37	+48 06 31.28	49.37	0.89	-68.81	0.84	10.00	1.03	27.42	0.50	(1;1;102,135)
33	V510 Per	19942	15041	03 13 51.23	+43 51 46.80	52.65	1.15	-76.22	0.59	5.65	0.90	40.68	0.09	(1;1;90)
34	BU 1178 AB	21018	15807	03 23 38.99	+04 52 55.58	-6.83	1.04	-2.56	0.82	2.92	0.95	7.38	0.19	(1;1;118)
35	UX Ari	21242	16042	03 26 35.39	+28 42 54.32	41.35	1.63	-104.29	1.07	19.91	1.25	26.53	0.22	(1;1;47)
36	IX Per	22124	16713	03 35 01.20	+32 01 00.38	54.98	2.34	-41.96	0.33	14.75	1.87	-21.00	7.20	(1;1;49)
37	V711 Tau	22468	16846	03 36 47.29	+00 35 15.93	-32.98	1.12	-163.45	0.62	34.52	0.87	-15.30	0.10	(1;1;46,58)
38	V837 Tau	22403	16879	03 37 11.04	+25 59 27.94	237.51	1.03	-271.86	0.75	26.78	0.95	-17.70	0.90	(1;1;153)
39	V1082 Tau	22694	17076	03 39 33.60	+18 23 05.69	188.20	1.68	-193.16	1.13	27.18	1.40	1.70	0.13	(1;1;116)
40	BD+44 801	23838	17932	03 50 04.42	+44 58 04.28	-37.80	0.90	-26.82	0.55	9.41	0.85	18.40	0.10	(1;1;130)
41	V471 Tau		17962	03 50 24.97	+17 14 47.42	130.49	1.69	-23.30	1.32	21.37	1.62	37.40	0.50	(1;1;31)
42	AG Dor	26354	19248	04 07 29.20	-52 34 17.13	146.98	1.00	-221.70	0.89	28.67	0.83	68.95	0.08	(1;1;162)
43	EI Eri	26337	19431	04 09 40.89	-07 53 34.29	34.53	1.33	101.52	0.81	17.80	0.97	17.60	0.20	(1;1;154)
44	V818 Tau	27130	20019	04 17 38.94	+16 56 52.29	113.07	1.29	-21.39	0.92	21.40	1.24	37.70	0.10	(1;1;97,122,124)
45	BD+17 703	27149	20056	04 18 01.84	+18 15 24.50	115.65	1.10	-31.23	0.82	21.84	1.14	38.00	0.30	(1;1;52)
46	STT 82 AB	27691	20440	04 22 44.17	+15 03 21.93	111.98	2.70	-19.88	1.57	21.45	2.76	38.20	0.90	(1;1;56)
47	V988 Tau	284414	20482	04 23 22.85	+19 39 31.23	98.53	1.93	-32.57	1.17	15.82	1.44	39.81	0.09	(1;1;97)
48	V918 Tau	28291	20890	04 28 37.21	+19 44 26.47	99.83	1.66	-39.82	0.79	20.09	1.11	39.81	0.08	(1;1;97)
49	V492 Per	28591	21144	04 31 56.95	+36 44 33.68	4.23	0.94	-67.69	0.47	8.47	0.87	6.38	0.08	(1;1;45)
50	V833 Tau	283750	21482	04 36 48.24	+27 07 55.90	232.36	1.51	-147.11	0.68	56.02	1.21	36.02	0.08	(1;1;97)
51	3 Cam	29317	21727	04 39 54.68	+53 04 46.33	-7.38	0.86	-15.95	0.72	6.58	0.78	-40.47	1.21	(1;1;40)
52	RZ Eri	30050	22000	04 43 45.83	-10 40 56.02	6.35	1.35	9.70	1.08	5.40	1.29	43.30	0.90	(1;1;135)
53	V808 Tau	283882	22394	04 49 12.99	+24 48 10.23	85.22	1.73	-52.07	1.09	18.96	1.62	40.60	0.43	(1;1;95)
54	BD+64 487	30957	22961	04 56 26.05	+64 24 09.64	38.22	0.76	-64.73	0.65	27.07	0.99	6.40	0.09	(1;1;68)
55	V1198 Ori	31738	23105	04 58 16.99	+00 27 14.24	-159.48	1.04	-13.46	0.65	29.85	1.04	6.60	0.60	(1;1;18)
56	BM Cam	32357	23743	05 06 12.14	+59 01 16.82	-1.83	0.75	-26.15	0.63	5.22	0.92	-2.00	0.60	(1;1;100)
57	HP Aur	280603		05 10 21.76	+35 47 46.90	-27.00	5.5	-24.00	5.5	3.49	0.17	20.00	0.60	(7;12;141)
58	YZ Men	34802	24085	05 10 26.75	-77 13 01.53	-19.19	0.69	-3.93	0.56	5.57	0.59	-4.20	0.60	(1;1;18)
59	alfa Aur	34029	24608	05 16 41.36	+45 59 52.77	75.52	0.78	-427.11	0.49	77.29	0.89	29.19	0.07	(1;1;142)
60	CL Cam	33363	24760	05 18 31.10	+75 56 49.30	7.66	0.74	5.89	0.53	7.31	0.70	-48.38	0.04	(1;1;74)

Table 1 – *continued*

ID	Name	HD	HIP	α(2000) (h m s)	δ(2000) (^{o} $'$ $''$)	$\mu_\alpha cos\delta$ (mas/yr)		μ_δ (mas/yr)		π (mas)		γ (km/s)		References
61	BD+10 828	37171	26386	05 37 04.38	+11 02 06.02	52.25	0.80	-16.18	0.55	3.97	0.82	-120.00	6.66	(1;1;26)
62	TW Lep	37847	26714	05 40 39.72	-20 17 55.58	26.11	1.35	-10.69	1.17	5.87	1.19	18.00	0.50	(1;1;18)
63	V1149 Ori	37824	26795	05 41 26.79	+03 46 40.94	34.52	1.16	6.16	0.74	6.93	1.13	26.90	0.30	(1;1;101)
64	V1197 Ori	38099	26953	05 43 09.32	-01 36 47.69	4.86	1.02	-29.07	0.61	4.80	0.95	32.06	0.14	(1;1;145)
65	TZ Col	39576	27727	05 52 15.99	-28 39 24.92	5.35	0.98	-19.72	0.78	11.41	1.07	24.25	3.40	(1;1;39)
66	SAO 234181	39937	27737	05 52 20.20	-57 09 22.29	17.99	0.58	-78.63	0.46	7.86	0.50	8.00	10.0	(1;1;56)
67	SZ Pic	39917	27843	05 53 27.36	-43 33 31.33	-3.43	0.63	-56.62	0.58	5.13	0.66	-23.45	2.80	(1;1;17)
68	V403 Aur	39743	28162	05 57 04.63	+49 01 46.88	-5.18	0.89	-7.39	0.54	5.59	0.87	-1.60	2.00	(1;1;165)
69	V1355 Ori	291095		06 02 40.36	+00 51 37.26	9.40	2.20	7.00	1.60	8.00	2.13	35.70	0.26	(6;11;157)
70	CQ Aur	250810	28715	06 03 53.65	+31 19 41.20	-3.45	1.72	-3.75	0.93	4.13	1.41	28.62	0.92	(1;1;102,136)
71	TY Pic	42504	29071	06 07 56.94	-54 26 21.35	6.71	0.66	17.65	0.60	3.49	0.60	48.90	0.40	(1;1;18)
72	V1358 Ori	43989	30030	06 19 08.06	-03 26 20.36	10.65	1.02	-42.47	0.69	20.10	0.99	-13.10	10.0	(1;1;129)
73	V1260 Ori	43930	30055	06 19 28.87	+13 26 54.06	10.15	1.44	-9.54	0.65	1.89	1.12	18.58	0.12	(1;1;144)
74	OU Gem	45088	30630	06 26 10.25	+18 45 24.86	-119.32	1.07	-164.06	0.75	68.20	1.10	-8.40	0.15	(1;1; 99)
75	TZ Pic	46697	31062	06 31 05.73	-59 00 16.58	32.47	0.67	49.33	0.57	5.69	0.60	10.40	0.40	(1;1;18)
76	SV Cam	44982	32015	06 41 19.07	+82 16 02.42	41.58	0.88	-152.91	0.74	11.77	1.07	-13.80	0.02	(1;1;117,147)
77	VV Mon		34003	07 03 18.29	+05 44 15.53	6.48	1.16	8.20	0.95	5.59	1.46	19.50	1.00	(1;1;135)
78	QY Aur		34603	07 10 01.83	+38 31 46.09	-439.62	5.40	-948.26	2.63	157.23	3.32	37.90	0.50	(1;1;161)
79	SS Cam		35197	07 16 24.74	+73 19 56.91	-1.40	1.49	-16.40	0.92	3.09	1.69	-19.70	2.00	(1;1;136)
80	SAO 235111	57853		07 20 21.43	-52 18 31.91	-78.0	4.90	147.0	4.70	36.97	10.60	17.60	0.70	(8;2;150)
81	AR Mon	57364	35600	07 20 48.45	-05 15 35.80	6.06	1.33	-7.07	0.85	3.62	1.22	11.92	0.60	(1;1;102,133)
82	YY Gem	60179C		07 34 37.40	+31 52 09.79	-207.60	4.20	-96.00	4.10	74.70	2.50	7.82	2.50	(8;2;32)
83	V344 Pup	61245	36992	07 36 13.80	-44 57 27.45	30.00	0.54	-17.77	0.46	8.98	0.55	1.60	0.50	(1;1;18)
84	sigma Gem	62044	37629	07 43 18.73	+28 53 00.64	61.84	0.88	-231.26	0.62	26.68	0.79	44.19	0.10	(1;1;34,48,54)
85	81 Gem	62721	37908	07 46 07.45	+18 30 36.16	-75.55	0.77	-51.53	0.47	9.55	0.83	83.13	0.08	(1;1;82)
86	BD+42 1790	65195		07 59 20.69	+41 47 04.82	-1.90	3.60	3.10	1.80	2.27	0.61	11.62	0.19	(6;9;85)
87	AE Lyn	65626	39348	08 02 35.78	+57 16 25.06	-38.28	0.78	-59.08	0.63	9.84	0.73	27.51	0.06	(1;1;69)
88	LU Hya	71071	41274	08 25 14.08	-07 10 12.85	-117.76	0.97	-9.56	0.73	20.20	0.90	27.80	0.40	(1;1;18)
89	BD+28 1600	71028		08 26 07.19	+28 24 10.67	-9.90	2.90	-2.80	1.70	3.48	0.93	30.00	11.5	(6;12;103)
90	GK Hya		41751	08 30 49.31	+02 16 26.57	-45.32	1.43	8.46	1.05	4.11	1.60	32.00	2.00	(1;1;134)
91	VX Pyx	72688	41939	08 32 58.50	-34 38 02.54	-18.26	0.48	3.27	0.42	7.65	0.59	8.90	0.60	(1;1;18)
92	RU Cnc		42303	08 37 30.13	+23 33 41.63	-22.25	1.85	-2.41	1.06	3.02	1.58	1.72	0.36	(1;1;108)
93	RZ Cnc	73343	42432	08 39 08.54	+31 47 44.48	-4.56	1.63	-14.19	0.99	3.25	1.56	12.20	1.20	(1;1;133)
94	TY Pyx	77137	44164	08 59 42.72	-27 48 58.69	-43.99	0.55	-44.80	0.47	17.91	0.74	63.20	1.00	(1;1;15)
95	WY Cnc		44349	09 01 55.45	+26 41 22.75	-13.11	1.90	-47.38	1.41	11.76	1.72	-12.70	1.00	(1;1;132)
96	XY UMa	237786	44998	09 09 55.94	+54 29 17.71	-48.08	1.74	-184.67	1.16	15.09	1.48	-9.98	0.83	(1;1;132,148)
97	BD+40 2194	80492	45875	09 21 15.47	+39 39 59.33	-45.87	1.24	-15.04	0.58	6.44	1.00	14.05	0.14	(1;1;98)
98	BF Lyn	80715	45963	09 22 25.95	+40 12 03.82	-341.42	1.33	-358.82	0.64	41.19	1.08	-3.20	1.16	(1;1;22)
99	IL Hya	81410	46159	09 24 49.02	-23 49 34.72	-37.51	0.74	-32.20	0.54	8.36	0.86	-7.27	0.08	(1;1;74)
100	IN Vel	83442	47206	09 37 12.96	-42 01 14.48	-72.49	1.00	19.53	0.76	3.50	1.19	48.70	1.60	(1;1;18)
101	DY Leo	85091	48215	09 49 48.51	+11 06 23.08	-315.63	1.10	-61.60	0.45	23.35	0.97	43.51	0.10	(1;1;115)
102	DH Leo	86590	49018	10 00 01.71	+24 33 09.87	-234.37	1.13	-36.11	0.78	30.82	1.29	9.80	0.90	(1;1;20)
103	XY Leo		49136	10 01 40.43	+17 24 32.70	56.75	1.68	-58.27	0.71	15.86	1.80	-37.70	0.70	(1;1;21)
104	FG Uma	89546	50752	10 21 47.46	+60 54 46.21	-75.57	0.58	-19.35	0.35	5.73	0.83	28.88	0.09	(1;1;70)
105	DW Leo	90385	51080	10 26 11.48	+14 54 00.55	25.24	1.03	-6.72	0.56	5.52	1.02	15.80	0.20	(1;1;147)
106	LR Hya	91816	51884	10 36 02.21	-11 54 47.92	141.89	0.88	-260.07	0.67	29.56	0.92	1.20	0.10	(1;1;59)
107	UV Leo	92109	52066	10 38 20.77	+14 16 03.67	-2.06	1.14	20.12	0.75	10.85	1.16	-13.30	0.60	(1;1;140)
108	DM Uma		53425	10 55 43.55	+60 28 09.73	-35.97	1.11	-6.96	0.68	7.21	1.28	-6.90	1.20	(1;1;43)
109	BD+23 22 97	95559	53923	11 02 02.27	+22 35 45.50	-140.79	1.27	4.91	0.82	18.43	1.19	3.81	0.11	(1;1;64)
110	DS Leo	95650	53985	11 02 38.34	+21 58 01.70	141.43	1.47	-51.13	0.96	85.70	1.36	3.90	2.30	(1;1;111)
111	FK Uma		55135	11 17 14.56	+29 34 14.23	-211.89	1.52	8.96	0.92	9.23	1.34	46.36	0.12	(1;1;115)
112	ξ UMa B	98230		11 18 10.92	+31 31 45.10	-456.00	2.50	-595.00	2.50	113.20	4.60	-15.50	0.08	(3;2;92)
113	SZ Crt	98712	55454	11 21 26.66	-20 27 13.62	178.48	1.73	-115.16	0.92	76.00	1.70	4.90	2.50	(1;1;19)
114	TV Crt	98800	55505	11 22 05.29	-24 46 39.76	-85.45	2.30	-33.37	1.67	21.43	2.86	9.25	3.00	(1;1;114)
115	BD+36 2193		56132	11 30 22.38	+35 50 30.18	-249.20	2.04	14.18	1.50	10.91	1.69	-17.62	0.16	(1;1;115)
116	EE Uma	99967	56135	11 30 24.83	+46 39 27.12	-5.36	0.66	27.66	0.40	3.31	0.78	27.72	0.11	(1;1;112)
117	V829 Cen	101309	56851	11 39 22.24	-39 23 07.60	-1.46	0.86	52.28	0.55	8.22	0.83	7.60	0.80	(1;1;18)
118	GT Mus	101379J	56862	11 39 29.90	-65 23 52.96	-28.52	0.72	-7.01	0.60	5.81	0.64	9.10	0.40	(1;1;18)
119	RW UMa		56974	11 40 46.35	+51 59 53.41	-25.93	1.53	-5.02	1.25	4.13	1.86	-25.00	1.00	(1;1;136)
120	DQ Leo	102509	57565	11 47 59.14	+20 13 08.15	-145.47	0.96	-4.04	0.67	14.40	0.86	0.50	0.21	(1;1;142)

Table 1 – *continued*

ID	Name	HD	HIP	α(2000) (h m s)	δ(2000) (^{o} $'$ $''$)	$\mu_\alpha cos\delta$ (mas/yr)		μ_δ (mas/yr)		π (mas)		γ (km/s)		References
121	HU Vir	106225	106225	12 13 20.69	-09 04 46.88	-11.7	1.09	-0.43	0.56	8.00	1.25	-0.66	0.12	(1;1;74)
122	DK Dra	106677	59796	12 15 41.49	+72 33 04.31	-9.20	0.57	-25.11	0.50	7.24	0.55	-45.29	0.07	(1;1;37)
123	AS Dra	107760	60331	12 22 11.73	+73 14 54.54	-455.39	0.82	184.34	0.58	23.16	0.67	-98.90	0.10	(1;1;122)
124	IL Com	108102	60582	12 25 02.26	+25 33 38.36	-9.94	1.12	-8.97	0.67	9.34	1.06	-0.40	0.50	(1;1;113)
125	HZ Com			12 29 40.92	+24 31 14.65	-10.80	2.90	-7.60	2.30	16.60	0.83	-0.56	0.24	(6;12;44)
126	IM Vir	111487		12 49 38.70	-06 04 44.86	26.50	1.60	-57.30	1.60	16.67	0.84	12.30	2.00	(6;9;120)
127	IN Com	112313	63087	12 55 33.75	+25 53 30.60	-24.54	1.13	0.05	0.81	1.41	0.38	-16.50	0.20	(1;10;109)
128	UX Com		63561	13 01 33.02	+28 37 54.16	-58.31	2.32	-4.13	1.37	5.94	1.80	-9.89	1.00	(1;1;102,136)
129	IS Vir	113816	63958	13 06 26.02	-04 50 45.30	-3.19	1.09	-19.23	0.61	3.33	1.01	21.25	0.04	(1;1;70)
130	RS CVn	114519	64293	13 10 36.91	+35 56 05.59	-49.14	0.89	21.49	0.71	9.25	1.06	-13.62	0.44	(1;1;51,134)
131	SAO 240653	114630	64478	13 12 55.72	-59 48 59.78	8.23	0.58	-107.89	0.34	25.12	0.72	15.47	0.10	(1;1;150)
132	BL CVn	115781	64956	13 18 51.90	+33 26 19.29	-1.30	0.94	6.80	0.65	3.51	0.95	-10.46	0.28	(1;1;88)
133	BM CVn	116204	65187	13 21 32.26	+38 52 49.53	-59.96	0.62	-14.15	0.52	9.00	0.76	7.80	0.14	(1;1;88)
134	BD+36 2368	116378	65274	13 22 40.33	+35 55 43.41	-98.25	0.95	54.20	0.75	8.74	1.21	-42.70	1.02	(1;1;84)
135	IN Vir	116544	65411	13 24 24.15	-02 18 54.93	60.94	1.37	-141.68	0.74	8.82	1.45	39.50	0.50	(1;1;155)
136	BH CVn	118216	66257	13 34 47.81	+37 10 56.69	84.70	0.45	-9.81	0.39	22.46	0.62	6.43	0.24	(1;1;53)
137	IT Com	118234	66286	13 35 08.12	+20 46 54.78	-118.54	1.34	-37.69	0.62	6.48	1.07	-19.24	1.02	(1;1;89)
138	V764 Cen	118238	66358	13 36 08.32	-33 28 44.81	-1.98	1.09	-4.43	0.72	1.97	1.19	9.30	0.30	(1;1;18)
139	BD+02 2705	118981	66708	13 40 26.99	+02 09 06.02	62.01	0.99	-200.82	0.59	14.44	1.13	22.05	0.12	(1;1;115)
140	V851 Cen	119285	67013	13 44 00.92	-61 21 59.15	22.07	1.21	16.68	0.79	13.13	1.34	93.30	0.65	(1;1;150)
141	BH Vir	121909	68258	13 58 24.86	-01 39 38.95	4.63	0.88	-5.89	0.74	7.94	1.50	-22.80	2.70	(1;1;13,166)
142	FR Boo	122767	68660	14 03 15.73	+24 35 50.84	12.81	0.88	-19.19	0.74	2.95	0.79	-22.10	0.66	(1;12;87)
143	4 Umi	124547	69112	14 08 50.93	+77 32 51.05	-30.36	0.51	33.39	0.44	6.52	0.49	5.85	0.11	(1;1;151)
144	V841 Cen	127535		14 34 16.05	-60 24 28.92	-103.20	3.60	-30.50	3.40	15.87	4.23	16.90	0.54	(6;9;52)
145	RV Lib	128171	71380	14 35 48.42	-18 02 11.54	-20.54	1.80	-18.86	1.37	2.70	2.08	-29.96	0.35	(1;1;108)
146	37 Boo	131156	72659	14 51 23.38	+19 06 01.66	152.81	0.82	-71.28	0.47	149.26	0.76	3.00	0.90	(1;1;56)
147	DE Boo	131511	72848	14 53 23.77	+19 09 10.07	-442.77	0.76	216.85	0.49	86.69	0.81	-31.00	0.20	(1;1;27)
148	SS Boo		74509	15 13 32.53	+38 34 05.55	-46.01	1.39	-21.79	1.18	4.95	1.39	-48.67	0.60	(1;1;102,136)
149	UV CrB	136901	75233	15 22 25.33	+25 37 26.93	15.02	1.09	-8.69	0.52	3.58	0.89	-19.73	0.18	(1;1;74)
150	GX Lib	136905	75325	15 23 26.06	-06 36 37.76	0.24	1.04	-123.20	0.76	10.51	1.00	61.28	0.35	(1;1;112)
151	LS TrA	137164	75689	15 27 45.68	-63 01 14.38	-53.14	0.78	-32.29	0.59	7.85	0.93	-21.70	6.40	(1;1;18)
152	UZ Lib		76086	15 32 23.21	-08 32 00.91	23.50	1.46	-0.97	1.00	7.12	1.33	17.69	0.40	(1;1;74)
153	RT CrB	139588	76551	15 38 03.03	+29 29 13.95	6.81	2.38	-1.46	1.26	3.45	0.92	-4.00	1.00	(1;4;136)
154	QX Ser	141690	77504	15 49 32.93	+25 27 36.75	-47.50	2.58	6.05	2.12	5.72	2.64	-30.57	0.10	(1;1;93)
155	RS UMi		77623	15 50 49.43	+72 12 40.61	3.93	1.23	-10.45	1.08	1.83	1.26	11.00	1.50	(1;1;136)
156	MS Ser	143313	78259	15 58 43.94	+25 34 10.40	-78.93	0.91	119.58	0.60	11.39	0.96	-4.45	0.14	(1;1;80)
157	NQ Ser	144515	78864	16 05 53.41	+10 41 06.04	-523.79	2.16	-41.47	1.53	24.81	1.58	-59.20	0.20	(1;1;122)
158	TZ CrB	146361	79607	16 14 40.85	+33 51 31.01	-266.47	1.16	-86.88	0.81	46.11	0.98	-12.30	0.06	(1;1;159)
159	V846 Her	148405		16 26 56.30	+24 14 07.21	-3.80	3.10	7.90	2.10	2.53	0.67	-33.72	0.12	(6;12;83)
160	CM Dra			16 34 20.40	+57 09 42.80	-1132.00	2.50	1130.00	2.50	68.00	4.00	-118.71	0.08	(3;5;126)
161	BD-03 3968	149414	81170	16 34 42.35	-04 13 44.65	-133.09	2.68	-704.00	1.65	20.71	1.50	-170.89	0.11	(1;1;121,123)
162	WW Dra	150708	81519	16 39 03.98	+60 41 58.79	24.76	1.68	-58.37	1.41	8.67	1.24	-29.00	2.00	(1;1;135)
163	epsilon UMi	153751	82080	16 45 58.24	+82 02 14.14	19.54	0.95	4.67	0.63	9.41	0.67	-10.57	0.40	(1;1;52)
164	V2253 Oph	152178	82583	16 52 56.01	-26 45 02.35	0.46	1.64	-14.30	0.97	2.12	1.24	-36.75	0.13	(1;1;74)
165	V792 Her	155638	84014	17 10 25.60	+48 57 56.27	3.50	0.77	-24.43	0.68	2.42	0.67	12.86	0.17	(1;1;66,128)
166	V832 Her	155989	84291	17 13 56.52	+26 10 50.77	6.67	0.88	14.37	0.74	3.04	0.81	-2.99	0.14	(1;9;81)
167	V824 Ara	155555	84586	17 17 25.50	-66 57 03.72	-21.34	0.67	-136.47	0.55	31.83	0.74	5.90	0.20	(1;1;158)
168	V819 Her	157482	84949	17 21 43.62	+39 58 28.74	5.67	1.63	-65.62	0.96	15.53	1.16	-3.37	0.14	(1;1;152)
169	V965 Sco	158393	85680	17 30 33.36	-33 39 15.90	-6.02	1.61	-5.68	0.94	2.46	1.38	-25.30	1.40	(1;1;57)
170	DR Dra	160538	85852	17 32 41.21	+74 13 38.48	-66.82	0.94	37.07	0.87	9.68	0.80	-11.55	0.07	(1;1;71)
171	V834 Her	160952	86579	17 41 37.44	+29 35 56.33	3.50	0.70	-28.68	0.60	4.81	0.78	27.88	0.12	(1;1;146)
172	BD+44 2760	161570		17 44 07.56	+44 04 51.74	2.10	1.60	11.30	1.60	3.23	0.16	-31.39	0.05	(1;61;61)
173	V826 Her	161832	86946	17 45 58.45	+39 19 21.14	5.35	0.66	13.98	0.59	2.92	0.65	-26.69	0.12	(1;1;112)
174	V835 Her	163621	87746	17 55 24.68	+36 11 19.93	-135.97	0.71	-20.28	0.59	32.37	0.70	-20.01	0.04	(1;1;96)
175	Z Her	163930	87965	17 58 06.98	+15 08 21.90	-23.63	0.74	74.25	0.58	10.17	0.84	-45.00	1.00	(1;1;134)
176	MM Her	341475	88008	17 58 38.52	+22 08 46.79	3.84	1.29	-31.88	0.98	5.42	1.56	-51.19	0.21	(1;1;108)
177	V772 Her	165590	88637	18 05 49.71	+21 26 45.23	-21.62	1.05	-40.54	0.91	26.51	1.35	-22.82	0.19	(1;1;24)
178	ADS 11060C	165590C	88639	18 05 50.00	+21 26 18.00	-21.62	1.05	-40.54	0.91	26.51	1.35	-22.70	0.12	(1;1;72)
179	V832 Ara	165141	88743	18 07 00.25	-48 14 50.23	3.71	0.95	8.63	0.54	3.75	0.94	9.20	2.30	(1;1;71)
180	V815 Her	166181	88848	18 08 15.67	+29 42 36.30	138.07	0.88	-18.58	0.74	30.69	2.08	-13.40	0.80	(1;1;127)

Table 1 – *continued*

ID	Name	HD	HIP	α(2000) (h m s)	δ(2000) (^{o} $'$ $''$)	$\mu_\alpha cos\delta$ (mas/yr)		μ_δ (mas/yr)		π (mas)		γ (km/s)		References
181	PW Her		89039	18 10 24.11	+33 24 11.18	15.82	1.42	9.77	1.08	4.31	1.29	-24.40	1.00	(1;1;102,136)
182	AW Her	348635	90312	18 25 38.72	+18 17 40.25	16.31	1.50	18.37	1.14	4.71	1.55	-45.60	0.15	(1;1;108)
183	BY Dra	234677	91009	18 33 59.45	+51 43 19.40	186.62	0.81	-324.90	0.66	60.90	0.73	-25.43	0.08	(1;1;30)
184	Omi Dra	175306	92512	18 51 12.10	+59 23 18.07	77.56	0.56	25.43	0.45	10.12	0.43	-19.53	0.31	(1;1;52)
185	35 Sqr	175190	92845	18 55 07.14	-22 40 16.78	110.34	1.27	-30.79	0.99	12.07	0.92	-107.00	4.48	(1;1;52)
186	V1285 Aql		92871	18 55 27.41	+08 24 09.02	92.03	2.05	-69.58	1.42	86.27	1.90	-13.49	0.17	(1;1;50)
187	V775 Her	175742	92919	18 55 53.22	+23 33 23.94	130.79	0.77	-283.07	0.55	46.64	1.03	10.31	0.06	(1;1;107)
188	Tau Sqr	177716	93864	19 06 56.41	-27 40 13.52	-50.79	3.41	-250.50	1.51	27.09	1.48	44.70	5.97	(1;1;52)
189	V478 Lyr	178450	93926	19 07 32.39	+30 15 16.17	111.96	0.70	103.03	0.61	35.70	0.78	-20.20	0.20	(1;1;65)
190	V1762 Cyg	179094	94013	19 08 25.79	+52 25 32.63	-100.41	0.52	-54.95	0.44	14.24	0.49	5.97	0.19	(1;1;129)
191	26 Aql	181391	95066	19 20 32.48	-05 24 56.76	113.42	0.80	44.83	0.54	21.17	0.77	-18.00	0.28	(1;1;52)
192	V1430 Aql			19 21 48.48	+04 32 56.92	17.20	1.70	-25.60	1.60	3.58	0.95	-20.00	5.00	(6;12;160)
193	V4138 Sqr	181809	95244	19 22 40.30	-20 38 34.45	5.29	0.86	-105.09	0.54	11.40	0.85	-12.70	0.30	(1;1;18)
194	V4139 Sqr	182776	95714	19 28 05.57	-40 50 04.98	28.04	1.78	-16.86	0.92	4.16	1.39	-39.10	0.60	(1;1;18)
195	V1817 Cyg	184398	96003	19 31 13.55	+55 43 54.61	-2.67	0.56	-18.19	0.50	3.10	0.50	-5.20	2.99	(1;1;52)
196	V1764 Cyg	185151	96467	19 36 42.58	+27 53 02.90	3.61	0.80	-13.90	0.62	3.44	0.90	-22.80	0.31	(1;1;63)
197	V1379 Aql	185510	96714	19 39 38.82	-06 03 49.46	22.77	1.20	-27.82	0.51	4.25	1.11	-21.87	0.10	(1;1;71)
198	V4200 Ser	188088	97944	19 54 17.75	-23 56 27.85	-122.67	0.81	-409.86	0.48	70.34	0.81	-5.10	0.20	(1;1;62)
199	V4091 Sqr	190540	99011	20 06 02.67	-18 42 15.76	-3.99	1.57	0.02	1.04	3.55	1.25	-29.90	0.40	(1;1;18)
200	BD+15 4053	191179		20 07 59.22	+16 09 58.10	5.90	3.30	-12.40	1.60	41.10	6.60	36.50	5.00	(1;2;56)
201	V1423 Aql	191262	99210	20 08 26.96	+15 40 29.86	-82.12	0.98	-94.02	0.89	17.93	1.07	-15.03	0.07	(1;1;94)
202	V1971 Cyg	193891		20 21 33.06	+32 18 50.93	23.20	1.90	21.40	1.80	3.64	0.97	-60.13	0.12	(6;9;90)
203	AT Cap	195040	101098	20 29 36.86	-21 07 34.72	1.88	1.69	-9.68	1.08	1.67	0.45	-21.90	0.80	(1;4;18)
204	MR Del	195434	101236	20 31 13.47	+05 13 08.50	307.95	5.26	280.06	4.14	22.53	5.13	-51.10	0.60	(1;1;41)
205	CG Cyg		103505	20 58 13.45	+35 10 29.66	5.73	4.32	-15.85	3.00	9.25	4.95	1.70	0.40	(1;1;139)
206	V1396 Cyg		103655	21 00 05.35	+40 04 13.00	614.41	2.52	-247.19	1.98	66.21	2.54	-33.74	0.18	(1;1;50)
207	ER Vul	200391	103833	21 02 25.91	+27 48 26.44	88.25	0.57	6.10	0.57	20.06	0.85	-24.60	0.50	(1;1;105)
208	BN Mic	202134	104894	21 14 52.71	-31 11 01.26	-54.46	1.20	-50.86	0.52	6.36	1.05	49.10	1.50	(1;1;18)
209	BU 163	202908	105200	21 18 34.88	+11 34 07.77	35.46	1.21	-49.01	0.66	19.79	1.18	6.24	0.04	(1;1;73)
210	BD+39 4529	203454	105406	21 21 01.42	+40 20 42.24	-18.89	0.48	-208.92	0.42	37.64	0.59	0.30	0.30	(1;1;153)
211	BH Ind	204128	106013	21 28 19.88	-52 49 14.56	11.37	1.18	0.09	0.70	3.22	1.36	7.40	0.60	(1;1;18)
212	HZ Aqr		106335	21 32 11.93	+00 13 18.13	415.32	2.51	27.96	1.43	20.26	2.00	-109.60	0.40	(1;1;13)
213	AS Cap	205249	106497	21 34 16.57	-13 29 01.48	15.94	1.44	3.62	0.81	4.90	1.13	-27.00	0.50	(1;1;18)
214	AD Cap	206046	106961	21 39 48.92	-16 00 21.04	44.45	1.97	-2.15	1.16	5.22	1.56	9.00	3.00	(1;1;137)
215	42 Cap	206301	107095	21 41 32.86	-14 02 51.40	-122.06	1.29	-308.64	0.66	30.73	0.92	-1.20	0.05	(1;1;75)
216	V2075 Cyg	208472	108198	21 55 14.46	+44 25 06.91	7.93	0.66	-19.65	0.48	6.37	0.71	10.16	0.08	(1;1;74)
217	GJ 841A		108405	21 57 41.21	-51 00 22.19	-30.94	4.36	-373.28	1.77	61.63	2.67	-8.10	1.70	(1;1;110)
218	FF Aqr		108644	22 00 36.42	-02 44 26.86	32.23	1.77	-12.40	0.74	7.91	1.50	29.00	2.00	(1;1;119)
219	RT Lac	209318	108728	22 01 30.74	+43 53 25.64	57.31	1.01	21.15	0.70	5.19	1.05	-53.26	0.78	(1;1;106,137)
220	HK Lac	209813	109002	22 04 56.61	+47 14 04.49	59.37	0.61	31.33	0.44	6.62	0.61	-23.60	0.30	(1;1;52)
221	AR Lac	210334	109303	22 08 40.82	+45 44 32.11	-52.48	0.58	47.88	0.39	23.79	0.59	-34.23	0.50	(1;1;77,136)
222	δ Cap	207098	107556	21 74 02.45	-16 07 38.23	263.26	1.23	-296.23	0.67	84.58	0.88	-3.40	0.80	(1;1;23)
223	KX peg	212280	110462	22 22 32.55	+30 21 26.89	-34.51	0.94	-10.45	0.79	6.89	0.91	3.99	0.27	(1;1;67)
224	V350 Lac	213389	111072	22 30 06.50	+49 21 23.08	-25.06	0.41	-30.28	0.38	8.18	0.56	5.36	0.31	(1;1;52)
225	FK Aqr	214479	111802	22 38 45.58	-20 37 16.08	450.59	0.88	-79.86	0.74	115.71	1.50	-8.70	0.69	(1;1;52)
226	IM Peg	216489	112997	22 53 02.27	+16 50 28.30	-20.97	0.62	-27.59	0.56	10.33	0.76	-14.41	0.04	(1;1;29,74)
227	AZ Psc	217188	113478	22 58 52.92	+00 18 57.38	56.03	1.15	13.88	0.86	6.78	0.88	-21.60	4.47	(1;1;52)
228	TZ PsA	217344	113598	23 00 28.16	-33 44 42.24	61.75	2.10	-155.27	1.33	15.20	1.67	36.90	1.50	(1;1;1)
229	KU Peg	218153	114025	23 05 29.27	+26 00 33.45	52.25	0.82	-4.03	0.52	5.33	0.91	-80.40	0.20	(1;1;164)
230	KZ And	218738	114379	23 09 57.36	+47 57 30.14	147.06	6.82	12.42	5.63	39.56	7.67	-6.85	0.59	(1;1;35)
231	RT And		114484	23 11 10.10	+53 01 33.04	-6.88	1.01	-20.64	0.80	13.26	1.13	0.60	0.60	(1;1;143)
232	SZ Psc	219113	114639	23 13 23.79	+02 40 31.58	18.11	1.22	26.06	0.81	11.34	0.92	12.00	2.00	(1;1;135)
233	EZ Peg		114944	23 16 53.35	+25 43 10.17	-72.24	1.05	9.05	0.70	7.72	1.29	-27.24	0.18	(1;1;86)
234	V368 Cep	220140	115147	23 19 26.63	+79 00 12.67	201.35	0.65	71.59	0.56	50.65	0.64	-16.80	2.00	(1;1;165)
235	lam And	222107	116584	23 37 33.84	+46 27 29.35	159.22	0.51	-421.46	0.33	38.74	0.68	6.84	0.18	(1;1;52)
236	KT Peg	222317	116740	23 39 30.97	+28 14 47.42	303.04	0.69	227.05	0.42	20.27	0.76	-3.10	0.40	(1;1;153)
237	II Peg	224085	117915	23 53 04.05	+28 38 01.24	576.16	0.80	34.34	0.55	23.62	0.89	-20.50	0.10	(1;1;28)

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Table 2. Kinematic data of the Chromospherically Active Binaries.

ID	Name	HD	l	b	X (pc)	Y (pc)	Z (pc)	U (km/s)		V (km/s)		W (km/s)		Code	MG	OC
1	BC Psc	28	93.75	-65.93	-1.1	16.0	-36.0	-6.97	0.39	11.07	0.60	12.31	0.34			
2	BD+45 4408	38	114.65	-16.32	-4.5	9.8	-3.2	-34.96	4.15	-31.19	8.79	-16.36	2.88	1	Hya	
3	5 Cet	352	98.34	-63.24	-20.1	137.1	-274.7	-9.45	2.40	-10.48	3.24	-4.35	1.50	1	Cas	
4	LN Peg		108.98	-47.25	-8.9	26.0	-29.7	-44.97	2.34	-47.19	1.84	-7.12	0.93			
5	BD Cet	1833	100.87	-70.86	-25.8	134.2	-393.6	37.43	20.02	-80.88	38.75	-25.19	14.50			
6	13 Cet	3196	112.90	-66.15	-3.3	7.8	-19.3	-34.81	0.81	-19.90	0.60	-13.49	0.38	1	Hya	
7	BK Psc		118.23	-52.11	-9.5	17.7	-25.9	-53.22	3.29	-68.92	3.70	-13.98	1.35			
8	FF And		120.96	-27.29	-10.9	18.1	-10.9	-27.87	1.38	-13.00	0.92	6.67	0.53	1	IC	
9	zeta And	4502	121.74	-38.60	-22.9	37.0	-34.7	39.01	1.39	-13.09	0.20	-1.21	0.77			
10	CF Tuc	5303	302.78	-42.48	34.4	-53.5	-58.2	-84.6	4.88	-50.01	2.96	-5.77	1.14			
11	eta And	5516	124.65	-39.43	-32.7	47.3	-47.3	21.55	1.05	-6.69	0.23	-6.35	0.75	1	Uma	
12	BE Psc	6286	126.45	-36.20	-103.3	139.9	-127.3	18.6	6.64	-12.56	3.96	1.12	5.80			
13	CS Cet	6628	162.96	-84.49	-12.1	3.7	-131.7	47.54	7.07	-27.66	4.06	-23.64	0.96			
14	AI Phe	6980	293.50	-70.53	34.1	-78.4	-241.7	-52.13	16.24	-37.58	11.46	6.46	1.46			
15	YR 20	7205	127.27	-21.04	-25.3	33.2	-16.1	-93.69	5.15	11.10	6.47	-27.05	3.05			
16	AY Cet	7672	137.75	-64.65	-24.9	22.6	-70.9	51.00	2.39	-4.90	0.29	13.63	0.77			
17	UV Psc	7700	134.15	-55.50	-24.9	25.6	-51.9	-26.21	1.94	-8.04	0.95	0.39	0.59	1	IC	
18	BC Phe	8435	249.49	-59.89	-20.7	-55.3	-101.9	18.09	1.87	-9.97	1.25	4.54	1.67	1	Uma	
19	BI Cet	8358	139.38	-61.15	-24.1	20.7	-57.6	93.89	4.11	-60.38	2.26	33.37	2.93			
20	AR Psc	8357	136.51	-54.62	-19.0	18.0	-36.8	-45.66	1.69	30.01	1.03	15.63	1.37			
21	BF Psc	9313	136.93	-45.72	-52.0	48.6	-73.0	30.28	2.57	-53.74	4.94	-37.65	5.10			
22	BB Scl	9770	231.70	-80.04	-2.5	-3.2	-23.3	-17.74	0.59	-1.96	0.35	-32.51	1.97			
23	UV For	10909	201.96	-77.16	-26.9	-10.8	-127.1	-109.49	15.49	-11.46	1.63	15.23	3.41			
24	XX Tri	12545	139.11	-25.00	-134.9	116.8	-83.2	52.35	8.15	9.12	5.35	-15.32	5.78			
25	TZ Tri	13480	142.98	-29.40	-65.1	49.1	-46.0	9.06	2.18	13.92	0.58	-40.72	2.71			
26	BQ Hyi	14643	293.54	-44.05	61.5	-141.1	-148.9	-19.31	5.88	-8.51	1.69	-7.39	1.44	1, 1	Cas, IC	
27	CC Eri	16157	258.48	-63.41	-1.0	-5.0	-10.3	6.46	0.17	-30.31	0.67	-32.67	1.34			
28	UX For	17084	244.72	-64.18	-7.5	-15.9	-36.3	-2.17	0.18	-26.88	0.68	-10.24	0.68	1	LA	
29	VY Ari	17433	150.58	-25.38	-34.6	19.5	-18.9	-22.1	0.98	-52.44	2.02	-8.24	0.42			
30	EP Eri	17925	192.07	-58.25	-5.3	-1.1	-8.8	-15.68	1.08	-21.95	0.28	-9.76	1.79	2, 1	LA, IC	
31	EL Eri	19754	185.96	-50.39	-139.1	-14.5	-168.9	-41.38	13.03	-35.84	13.97	19.71	11.91			
32	LX Per		145.99	-8.31	-82.0	55.3	-14.5	-42.82	2.00	-16.55	3.32	-19.40	1.64	1	Hya	α Per
33	V510 Per	19942	148.33	-11.87	-147.4	90.9	-36.4	-68.40	5.13	-42.80	10.23	-38.57	4.85			
34	BU 1178 AB	21018	177.72	-41.26	-257.2	10.2	-225.8	1.56	2.62	5.10	2.04	-13.09	2.91	1	Uma	
35	UX Ari	21242	159.55	-22.91	-43.3	16.2	-19.6	-26.29	0.33	-14.67	1.50	-23.05	0.85			
36	IX Per	22124	158.93	-19.19	-59.7	23.0	-22.3	9.80	6.44	-27.70	3.62	7.17	2.41			
37	V711 Tau	22468	184.91	-41.57	-21.6	-1.9	-19.2	24.26	0.34	-12.76	0.37	-2.90	0.35			
38	V837 Tau	22403	163.40	-23.57	-32.8	9.8	-14.9	1.01	0.94	-66.19	2.20	-1.95	0.50			
39	V1082 Tau	22694	169.47	-28.92	-31.7	5.9	-17.8	-9.10	0.43	-46.04	2.40	-2.86	0.25			
40	BD+44 801	23838	153.02	-7.22	-94.0	47.8	-13.4	-12.21	0.53	12.81	0.52	-24.63	2.05			
41	V471 Tau		172.48	-27.94	-41.0	5.4	-21.9	-43.90	0.96	-18.41	1.76	-2.61	1.19	2	Hya	Hya
42	AG Dor	26354	261.78	-45.80	-3.5	-24.1	-25.0	18.90	0.74	-75.26	0.81	-26.27	0.68			
43	EI Eri	26337	200.17	-39.38	-40.8	-15.0	-35.6	-31.56	1.07	8.88	0.79	5.13	0.93			
44	V818 Tau	27130	177.62	-23.36	-42.9	1.8	-18.5	-41.77	0.44	-18.08	1.16	-0.32	0.88	2	Hya	Hya
45	BD+17 703	27149	176.61	-22.43	-42.2	2.5	-17.5	-41.94	0.46	-19.03	1.13	-1.09	0.74	2	Hya	Hya
46	STT 82 AB	27691	180.06	-23.63	-42.7	0.0	-18.7	-41.54	1.20	-19.01	2.50	-0.31	2.02	2	Hya	Hya
47	V988 Tau	284414	176.36	-20.56	-59.1	3.8	-22.2	-44.62	0.70	-23.71	2.43	1.05	1.44	2	Hya	Hya
48	V918 Tau	28291	177.14	-19.56	-46.8	2.3	-16.7	-42.66	0.32	-20.11	1.25	-1.99	0.70	2	Hya	Hya
49	V492 Per	28591	164.50	-7.76	-112.7	31.3	-15.9	-11.73	0.52	-27.35	3.03	-24.51	2.47	1	LA	
50	V833 Tau	283750	172.52	-13.36	-17.2	2.3	-4.1	-39.28	0.13	-17.22	0.48	-1.61	0.18	2	Hya	
51	3 Cam	29317	153.32	4.26	-135.4	68.0	11.3	31.16	1.16	-21.95	0.89	-14.57	1.49			
52	RZ Eri	30050	208.00	-33.16	-136.9	-72.8	-101.3	-36.71	1.85	-14.26	1.19	-16.40	2.05			
53	V808 Tau	283882	176.18	-12.68	-51.3	3.4	-11.6	-43.07	0.52	-20.47	2.01	-0.44	0.82	2	Hya	Hya
54	BD+64 487	30957	145.82	13.08	-29.8	20.2	8.4	-13.33	0.30	-7.07	0.41	0.06	0.13	1, 1	Cas, IC	
55	V1198 Ori	31738	198.71	-24.72	-28.8	-9.8	-14.0	0.16	0.55	11.61	0.52	-23.59	0.78			
56	BM Cam	32357	150.95	10.83	-164.5	91.4	36.0	-12.17	2.09	-15.19	2.65	-15.31	2.71	1	LA	
57	HP Aur	280603	170.16	-2.37	-282.1	48.9	-11.8	-19.80	1.44	-0.71	7.37	-49.65	7.83	1, 1	Cas, IC	
58	YZ Men	34802	289.30	-31.92	50.4	-143.8	-94.9	8.10	0.75	13.20	1.21	-10.03	1.42			
59	alfa Aur	34029	162.59	4.57	-12.3	3.9	1.0	-35.93	0.11	-13.98	0.26	-8.94	0.14	1	Hya	
60	CL Cam	33363	136.75	20.92	-93.1	87.6	48.8	32.80	0.33	-31.57	0.34	-11.49	0.70			

Table 2 – *continued*

ID	Name	HD	l	b	X (pc)	Y (pc)	Z (pc)	U (km/s)		V (km/s)		W (km/s)		Code	MG	OC
61	BD+10 828	37171	194.33	-11.02	-239.6	-61.2	-48.1	119.68	6.39	-19.33	10.29	65.88	9.00			
62	TW Lep	37847	224.25	-24.32	-111.2	-108.3	-70.2	-2.66	1.47	-27.19	3.36	7.58	3.20			
63	V1149 Ori	37824	201.33	-13.71	-130.6	-51.0	-34.2	-25.12	0.50	-18.42	1.61	15.66	3.66			
64	V1197 Ori	38099	206.44	-15.90	-179.4	-89.2	-57.1	-10.63	2.90	-36.93	4.73	-17.58	1.96			
65	TZ Col	39576	233.87	-24.71	-46.9	-64.3	-36.6	-4.27	1.95	-22.50	2.55	-10.61	1.47	1	LA	
66	SAO 234181	39937	265.48	-30.41	-8.6	-109.4	-64.4	50.01	3.11	-14.53	8.61	2.60	5.09			
67	SZ Pic	39917	250.03	-28.40	-58.6	-161.2	-92.7	61.21	6.48	8.33	2.75	-0.83	2.10			
68	V403 Aur	39743	163.58	11.96	-167.9	49.5	37.1	-2.19	1.92	-2.99	0.89	-6.99	1.31	1	Cas	
69	V1355 Ori	291095	208.08	-11.23	-108.2	-57.7	-24.3	-31.43	0.66	-15.02	0.97	0.28	2.17	1	Hya	
70	CQ Aur	250810	179.93	4.62	-241.3	0.3	19.5	-28.99	0.94	-1.22	1.48	-3.23	2.61			
71	TY Pic	42504	262.65	-27.94	-32.4	-251.1	-134.3	-21.65	4.03	-45.71	0.75	-11.86	2.07			
72	V1358 Ori	43989	212.32	-8.75	-41.6	-26.3	-7.6	17.34	8.36	-1.30	5.30	-0.28	1.54	1	Uma	
73	V1260 Ori	43930	197.35	-0.82	-505.0	-157.8	-7.6	-3.72	5.80	-35.99	18.88	10.87	7.37			
74	OU Gem	45088	193.41	3.09	-14.2	-3.4	0.8	9.04	0.15	-4.27	0.12	-13.07	0.22			
75	TZ Pic	46697	268.28	-25.56	-4.8	-158.5	-75.8	-31.77	3.81	-23.06	1.51	26.36	3.30	1	Hya	
76	SV Cam	44982	131.57	26.52	-50.4	56.9	37.9	-37.66	4.03	-54.23	4.11	2.55	0.85			
77	VV Mon		219.39	0.01	-138.3	-113.5	0.0	-15.04	1.02	-5.52	1.29	9.79	2.30	2	IC	
78	QY Aur		178.95	19.90	-6.0	0.1	2.2	-43.53	0.50	-21.78	0.48	-7.77	0.49	2	Hya	
79	SS Cam		141.71	27.68	-224.9	177.6	150.3	-7.83	9.31	-29.00	10.39	-12.01	2.72	1	LA	
80	SAO 235111	57853	263.57	-17.00	-2.9	-25.7	-7.9	-22.23	6.06	-13.76	1.10	-7.05	0.83	2	IC	
81	AR Mon	57364	220.98	4.10	-208.0	-180.7	19.8	3.88	2.85	-16.15	3.15	3.56	1.86			
82	YY Gem	60179C	187.46	22.48	-12.3	-1.6	5.1	-12.40	2.30	-3.11	0.40	-10.35	1.08	1	Cas	
83	V344 Pup	61245	257.82	-11.53	-23.0	-106.7	-22.3	17.35	0.94	-6.68	0.58	9.33	0.66	1	Uma	
84	sigma Gem	62044	191.19	23.27	-33.8	-6.7	14.8	-32.64	0.24	-49.65	1.24	14.55	0.17			
85	81 Gem	62721	201.86	20.14	-17.8	-7.1	7.0	-74.37	0.09	-31.75	0.07	20.48	0.16			
86	BD+42 1790	65195	178.24	29.84	-381.9	11.7	219.2	-11.49	3.67	8.38	4.43	3.48	6.46			
87	AE Lyn	65626	160.33	32.05	-30.8	11.0	20.5	-29.45	0.22	-0.82	0.27	8.48	0.21	1	IC	
88	LU Hya	71071	230.67	17.13	-21.5	-26.2	10.4	-26.33	0.42	-18.89	0.31	-8.76	0.57	2	IC	
89	BD+28 1600	71028	194.90	32.09	-235.3	-62.6	152.7	-30.06	9.87	-7.88	3.44	4.06	7.62			
90	GK Hya		222.00	23.06	-166.4	-149.8	95.3	-52.22	13.6	-5.82	5.58	-25.38	14.85	1	Hya	
91	VX Pyx	72688	254.82	3.14	-34.2	-126.0	7.2	-7.06	0.70	-6.73	0.60	-7.41	0.67	1	Cas	
92	RU Cnc		201.28	33.13	-258.4	-100.6	181.0	-18.73	10.68	0.00	1.61	-27.85	15.25			
93	RZ Cnc	73343	191.76	35.65	-177.2	-36.9	129.8	-10.46	1.54	-15.84	5.06	0.66	2.72			
94	TY Pyx	77137	252.96	11.84	-17.1	-55.9	12.3	-15.92	0.32	-63.11	0.95	-4.34	0.81			
95	WY Cnc		199.47	39.31	-62.0	-21.9	53.9	9.71	0.89	-14.86	2.74	-15.67	1.41			
96	XY Uma	237786	162.72	41.67	-47.3	14.7	44.1	-13.23	2.08	-58.58	5.55	-9.18	0.73			
97	BD+40 2194	80492	182.80	45.05	-109.6	-5.4	109.9	-33.16	3.69	-12.19	1.91	-13.97	3.77	1	IC	
98	BF Lyn	80715	182.05	45.27	-12.7	-0.5	12.9	-17.34	0.91	-31.56	0.62	-22.80	0.92	2	LA	
99	IL Hya	81410	253.69	18.72	-3.2	-11.1	3.9	1.89	0.04	5.77	0.07	-5.04	0.05	1	Uma	
100	IN Vel	83442	268.70	7.61	-6.2	-283.1	37.8	-83.89	30.81	-52.43	2.14	-39.66	15.72			
101	DY Leo	85091	224.47	44.50	-21.8	-21.4	30.0	-65.72	1.84	-39.43	0.74	-14.20	1.86			
102	DH Leo	86590	206.86	51.53	-18.0	-9.1	25.4	-31.90	1.23	-12.97	0.51	-14.95	1.18	1, 1	Hya, IC	
103	XY Leo		217.80	49.74	-32.2	-25.0	48.1	39.32	2.27	1.64	1.56	-22.74	0.92			
104	FG Uma	89546	149.08	47.91	-100.4	60.1	129.5	-69.95	7.50	-16.96	3.94	-6.03	3.99			
105	DW Leo	90385	225.37	54.12	-74.6	-75.6	146.8	15.65	3.79	-6.93	0.48	22.75	1.91			
106	LR Hya	91816	258.41	38.98	-5.3	-25.8	21.3	41.51	1.28	-20.62	0.62	-12.94	0.44			
107	UV Leo	92109	228.70	56.46	-33.6	-38.3	76.8	1.56	0.67	13.08	0.89	-9.25	0.60			
108	DM Uma		145.36	51.39	-71.2	49.2	108.4	-17.66	3.64	-13.22	2.04	-13.50	1.76	2, 1	Cas, IC	
109	BD+23 2297	95559	210.24	64.83	-19.9	-11.6	49.1	-32.58	2.06	-10.89	0.68	-11.21	0.96	2, 1	Hya, IC	
110	DS Leo	95650	218.75	64.78	-3.9	-3.1	10.6	6.61	0.78	-1.20	0.62	6.35	2.08	1	Uma	
111	FK Uma		200.65	69.17	-36.1	-13.6	101.3	-111.26	13.98	-39.04	4.86	4.60	5.63			
112	ξ UMa B	98230	195.11	69.25	-3.0	-0.8	8.3	-2.36	0.33	-28.45	1.22	-20.26	0.25			
113	SZ Crt	98712	276 30	7.67	1.1	-10.4	8.0	13.86	0.37	-3.51	1.97	1.65	1.53	1	Uma	
114	TV Crt	98800	278.40	33.08	5.7	-38.4	26.0	-10.77	1.83	-17.64	2.82	-6.85	2.34	2	LA	
115	BD+36 2193		181.09	70.70	-30.3	-0.6	86.5	-90.92	15.01	-34.98	5.49	-50.74	5.29			
116	EE Uma	99967	156.83	64.78	-118.3	50.7	273.3	-30.43	4.37	38.11	7.84	11.06	3.32			
117	V829 Cen	101309	288.05	21.40	35.1	-107.7	44.4	-7.34	1.36	0.08	1.02	29.36	2.72	1	Cas	
118	GT Mus	101379J	295.53	-3.56	74.0	-155.0	-10.7	-10.95	2.17	-16.67	1.01	-12.45	1.40	1	LA	
119	RW Uma		146.23	61.81	-95.1	63.6	213.4	-16.32	11.11	-23.35	7.80	-27.84	2.85	1	IC	
120	DQ Leo	102509	235.00	73.93	-11.0	-15.7	66.7	-40.95	2.48	-21.29	1.29	-11.35	0.74	2	Hya	

Table 2 – *continued*

ID	Name	HD	l	b	X (pc)	Y (pc)	Z (pc)	U (km/s)		V (km/s)		W (km/s)		Code	MG	OC
121	HU Vir	106225	287.32	52.63	22.6	-72.4	99.3	-4.05	1.09	-3.11	0.66	-1.70	0.30	1	Cas	
122	DK Dra	106677	126.66	44.32	-59.0	79.3	96.5	16.14	0.34	-39.67	1.09	-20.93	0.85			
123	AS Dra	107760	125.84	43.71	-18.3	25.3	29.8	-49.66	2.63	-79.29	0.63	-105.84	1.09			
124	IL Com	108102	226.29	83.88	-7.9	-8.3	106.5	-1.82	0.57	-6.39	0.84	-1.05	0.51	1	Cas	Com Ber
125	HZ Com		239.77	84.45	-2.9	-5.0	60.0	-1.38	0.79	-3.37	0.72	-0.92	0.25	1	Cas	Com Ber
126	IM Vir	111487	302.12	56.79	17.5	-27.8	50.2	18.10	1.00	-13.11	1.08	1.42	1.75			
127	IN Com	112313	339.90	88.46	17.9	-6.6	709.0	-69.20	18.91	-45.16	12.59	-15.17	0.42			
128	UX Com		67.45	87.31	3.0	7.3	168.2	-37.04	11.23	-29.23	8.83	-7.97	1.16	1	Hya	
129	IS Vir	113816	309.96	57.82	102.7	-122.6	254.2	19.37	2.98	-31.08	6.80	3.76	4.34			
130	RS CVn	114519	99.26	80.30	-2.9	18.0	106.6	-27.03	3.11	-7.87	0.76	-13.22	0.44	1	IC	
131	SAO 240653	114630	305.63	2.94	23.2	-32.3	2.0	10.37	0.11	-13.56	0.11	-19.60	0.59			
132	BL CVn	115781	81.44	81.35	6.4	42.4	281.7	-8.26	2.18	4.72	1.99	-11.13	0.39			
133	BM CVn	116204	96.68	76.67	-3.0	25.4	108.1	-21.68	1.78	-22.59	2.08	12.75	0.46			
134	BD+36 2368	116378	87.81	78.98	0.8	21.9	112.3	-61.14	8.35	-16.58	1.26	-39.82	1.05			
135	IN Vir	116544	319.32	59.50	43.6	-37.5	97.7	77.96	10.17	-49.66	6.02	-7.55	6.85			
136	BH CVn	118216	83.32	76.41	1.2	10.4	43.3	15.10	0.43	10.76	0.28	3.60	0.25			
137	IT Com	118234	2.81	78.18	31.6	1.5	151.0	-54.96	8.46	-74.78	12.32	-7.41	2.14			
138	V764 Cen	118238	313.53	28.47	307.3	-323.5	242.0	12.65	2.33	-14.62	5.13	-3.93	5.29			
139	BD+02 2705	118981	330.18	62.40	27.8	-16.0	61.4	57.83	3.81	-42.53	2.94	-12.19	2.49			
140	V851 Cen	119285	309.19	0.86	48.1	-59.0	1.1	67.51	0.89	-66.67	0.82	5.69	0.53			
141	BH Vir	121909	334.85	57.00	62.1	-29.2	105.6	-6.77	1.56	4.27	0.80	-21.52	2.32			
142	FR Boo	122767	28.05	73.66	84.2	44.8	325.3	28.07	9.40	-13.52	3.06	-28.77	2.16			
143	4 Umi	124547	117.67	38.78	-55.5	105.9	96.1	-35.34	2.30	-1.75	0.52	-7.34	0.87			
144	V841 Cen	127535	315.30	-0.03	44.8	-44.3	0.0	-9.25	6.05	-34.71	6.11	3.49	1.39			
145	RV Lib	128171	335.10	38.23	263.9	-122.5	229.2	-32.10	11.06	-36.85	35.63	-26.98	6.82			
146	37 Boo	131156	23.09	61.36	3.0	1.3	5.9	5.72	0.40	2.13	0.17	0.07	0.79	1	Uma	
147	DE Boo	131511	23.55	60.94	5.1	2.2	10.1	-36.24	0.23	-13.49	0.09	-14.04	0.21	1	Hya	
148	SS Boo		63.16	58.28	48.0	94.8	171.8	-21.02	2.26	-64.38	11.69	-16.63	7.01			
149	UV CrB	136901	39.11	56.28	120.3	97.8	232.3	7.58	4.74	-1.59	1.75	-28.47	3.11			
150	GX Lib	136905	356.02	40.10	72.6	-5.1	61.3	69.11	2.15	-44.80	3.96	9.76	2.85			
151	LS TrA	137164	319.62	-5.33	96.6	-82.2	-11.8	-38.37	5.64	-14.92	5.36	3.98	0.75	1	Hya	
152	UZ Lib		356.22	37.17	111.7	-7.4	84.9	22.02	1.57	8.68	2.02	1.34	1.89			
153	RT CrB	139588	46.68	53.45	118.5	125.6	233.0	0.85	2.61	2.94	2.78	-8.89	2.59	1	Uma	
154	QX Ser	141690	40.94	50.25	84.4	73.3	134.4	-37.31	9.62	-35.68	10.62	1.76	11.74			
155	RS UMi		106.88	38.83	-123.6	407.3	342.6	14.50	19.53	11.88	3.34	13.00	4.92			
156	MS Ser	143313	41.80	48.26	43.6	39.0	65.5	-54.71	4.34	7.18	0.83	25.39	2.43			
157	NQ Ser	144515	22.84	41.51	27.8	11.7	26.7	-73.17	2.06	-87.58	4.49	24.91	4.10			
158	TZ CrB	146361	54.67	46.14	8.7	12.3	15.6	-6.92	0.09	-29.16	0.48	9.45	0.40	1	LA	
159	V846Her	148405	42.20	41.73	218.5	198.1	263.1	-37.67	5.04	-13.12	4.49	-14.36	4.76			
160	CM Dra		86.57	40.91	0.7	11.1	9.6	-102.63	5.71	-122.23	1.93	-33.40	2.61			
161	BD-03 3968	149414	11.66	27.71	41.9	8.6	22.5	-88.66	4.33	-172.47	10.28	-136.26	4.14			
162	WW Dra	150708	90.86	39.45	-1.3	89.1	73.3	32.20	4.97	-18.84	1.73	-22.12	1.55			
163	epsilon UMi	153751	115.00	31.05	-38.5	82.5	54.8	1.68	0.34	-2.49	0.59	-13.86	0.74	1	Uma	
164	V2253 Oph	152178	355.14	10.81	461.7	-39.3	88.5	-33.14	1.27	-22.84	14.77	-27.04	12.19	1, 1	Hya, IC	
165	V792 Her	155638	75.41	36.39	83.8	321.9	245.2	41.19	13.17	2.17	2.32	1.49	2.09			
166	V832 Her	155989	48.24	32.06	185.7	208.0	174.6	-24.39	4.64	15.31	4.81	-4.48	1.39			
167	V824 Ara	155555	324.90	-16.30	24.7	-17.3	-8.8	-7.63	0.34	-17.53	0.36	-9.33	0.21	2	LA	
168	V819 Her	157482	64.69	33.58	22.9	48.5	35.6	16.27	1.43	-8.51	0.54	-5.92	0.52	1	Uma	
169	V965 Sco	158393	354.29	0.19	404.5	-40.4	1.3	-25.63	1.66	-13.90	8.96	3.58	3.46			
170	DR Dra	160538	105.49	31.35	-23.6	85.0	53.7	-18.94	1.65	-30.23	1.74	18.42	2.06			
171	V834 Her	160952	54.07	27.21	108.5	149.7	95.1	34.64	3.95	8.92	1.83	2.34	1.79			
172	BD+44 2760	161570	70.26	30.15	90.4	252.0	155.5	-31.86	2.38	-19.98	1.39	-15.93	2.03	1	IC	
173	V826 Her	161832	64.97	28.88	126.9	271.7	165.4	-38.37	4.78	-9.79	2.68	-15.91	1.15	1	Hya	
174	V835 Her	163621	62.06	26.30	13.0	24.5	13.7	-5.64	0.11	-26.92	0.25	7.61	0.37	1	LA	
175	Z Her	163930	40.87	18.49	70.5	61.0	31.2	-57.47	2.08	-12.61	1.44	8.65	1.95			
176	MM Her	341475	47.78	21.11	115.7	127.5	66.5	-14.05	6.23	-48.63	3.81	-30.98	3.75			
177	V772 Her	165590	47.76	19.30	23.9	26.4	12.5	-9.33	0.35	-21.70	0.34	-6.78	0.19	2	LA	
178	ADS 11060C	165590C	47.75	19.29	23.9	26.4	12.5	-9.25	0.33	-21.61	0.33	-6.74	0.18	2	LA	
179	V832 Ara	165141	345.06	-13.06	251.0	-67.0	-60.3	13.67	2.32	8.51	3.03	-1.47	1.22			
180	V815 Her	166181	56.20	21.76	16.8	25.1	12.1	-7.00	0.43	-1.40	0.87	-24.51	1.36			

Table 2 – *continued*

ID	Name	HD	l	b	X (pc)	Y (pc)	Z (pc)	U (km/s)		V (km/s)		W (km/s)		Code	MG	OC
181	PW Her		60.13	22.54	106.7	185.8	88.9	-27.40	3.53	-7.63	3.83	-21.44	3.90			
182	AW Her	348635	46.68	13.77	141.5	150.0	50.5	-50.46	5.33	-15.09	5.82	-17.95	2.73	1	Hya	
183	BY Dra	234677	80.56	23.57	2.5	14.8	6.6	17.68	0.27	-18.38	0.10	-28.86	0.23			
184	Omi Dra	175306	89.31	23.14	1.1	90.9	38.8	-23.20	0.90	-5.07	0.63	-37.25	1.29	1	IC	
185	35 Sqr	175190	12.91	-10.89	79.3	18.2	-15.7	-112.73	4.36	-18.35	1.13	-23.37	3.46			
186	V1285 Aql		40.87	2.93	8.8	7.6	0.6	-9.43	0.14	-9.47	0.13	-6.92	0.17	1	Cas	
187	V775 Her	175742	54.58	9.58	12.3	17.2	3.6	24.26	0.42	-0.16	0.20	-22.34	0.54			
188	Tau Sqr	177716	9.33	-15.37	35.1	5.8	-9.8	47.15	5.69	-36.72	2.58	-20.43	1.74			
189	V478 Lyr	178450	61.85	10.12	13.0	24.3	4.9	-25.96	0.37	-7.55	0.28	-10.93	0.19	1	IC	
190	V1762 Cyg	179094	82.98	18.74	8.1	66.0	22.6	26.50	0.96	-5.88	0.44	25.54	0.83			
191	26 Aql	181391	31.40	-8.93	39.8	24.3	-7.3	-28.86	0.54	6.55	0.61	-15.18	0.68			
192	V1430 Aql		40.46	-4.65	211.8	180.7	-22.6	-9.70	4.89	-30.10	5.71	-34.20	9.77	1	LA	
193	V4138 Sqr	181809	17.51	-15.90	80.5	25.4	-24.0	-5.64	0.59	-42.84	2.92	-15.25	1.44			
194	V4139 Sqr	182776	357.73	-23.92	219.6	-8.7	-97.5	-50.45	5.09	-8.17	3.24	-17.07	11.15	1	Hya	
195	V1817 Cyg	184398	87.51	16.87	13.4	308.4	93.6	18.58	4.46	-4.03	2.87	-8.61	1.65	1	Uma	
196	V1764 Cyg	185151	62.68	3.38	133.2	257.8	17.1	-4.36	3.52	-26.40	1.62	-14.97	3.72			
197	V1379 Aql	185510	32.97	-13.47	192.0	124.5	-54.8	-19.43	0.77	-30.47	4.85	-30.47	9.37	1	LA	
198	V4200 Ser	188088	17.17	-23.91	12.4	3.8	-5.8	3.21	0.20	-29.12	0.33	0.34	0.10			
199	V4091 Sqr	190540	23.61	-24.57	234.7	102.6	-117.1	-25.03	1.49	-12.43	1.38	16.94	2.43			
200	BD+15 4053	191179	56.26	-8.82	13.4	20.0	-3.7	20.09	2.76	29.32	4.11	-6.91	0.86			
201	V1423 Aql	191262	55.90	-9.17	30.9	45.6	-8.9	17.88	1.65	-29.89	1.06	7.75	0.41			
202	V1971 Cyg	193891	71.54	-2.55	86.9	260.3	-12.2	-64.27	10.42	-44.87	3.37	-6.35	3.42			
203	AT Cap	195040	23.29	-30.61	474.3	204.2	-305.5	-20.06	3.00	-33.61	7.36	-1.22	5.22			
204	MR Del	195434	49.72	-19.41	27.1	31.9	-14.8	-101.44	15.83	11.13	10.94	-6.53	5.45			
205	CG Cyg		78.46	-6.87	21.5	105.2	-12.9	1.51	2.83	-0.13	1.07	-7.64	4.43	1	Uma	
206	V1396 Cyg		82.44	-3.96	2.0	14.9	-1.0	-20.58	0.62	-34.40	0.18	-42.39	1.72			
207	ER Vul	200391	73.34	-12.31	14.0	46.7	-10.6	-22.98	0.66	-21.97	0.47	-9.46	0.65	2	IC	
208	BN Mic	202134	14.41	-43.01	111.4	28.6	-107.3	67.30	5.63	-28.27	6.12	-8.77	4.26			
209	BU 163	202908	62.55	-25.51	21.0	40.5	-21.8	2.34	0.23	-2.24	0.44	-15.24	0.78	1	Uma	
210	BD+39 4529	203454	85.37	-6.71	2.1	26.3	-3.1	19.48	0.32	-3.31	0.30	-16.70	0.27	2	Uma	
211	BH Ind	204128	344.13	-44.70	212.3	-60.4	-218.4	-5.39	5.27	-2.61	1.06	-16.77	5.05	1	Cas	
212	HZ Aqr		54.22	-34.93	23.7	32.8	-28.3	-127.64	7.34	-73.77	0.37	-0.32	6.25			
213	AS Cap	205249	39.26	-42.13	117.2	95.8	-136.9	-30.72	3.11	-10.86	0.88	8.79	2.38			
214	AD Cap	206046	36.82	-44.36	109.6	82.1	-133.9	-26.55	9.08	-1.41	2.19	-33.49	8.48			
215	42 Cap	206301	39.55	-43.97	18.1	14.9	-22.6	30.18	0.95	-41.10	1.22	-0.93	0.15			
216	V2075 Cyg	208472	92.84	-7.92	-7.7	155.3	-21.6	-0.09	0.68	8.22	0.23	-16.36	1.72			
217	GJ 841A		344.76	-49.56	10.2	-2.8	-12.3	-3.25	1.10	-26.36	1.24	13.80	1.35	1	LA	
218	FF Aqr		56.26	-42.46	51.8	77.6	-85.3	-1.93	2.52	9.19	2.06	-34.39	3.19			
219	RT Lac	209318	93.41	-9.03	-11.3	190.0	-30.2	-55.09	10.76	-58.23	1.40	-7.97	3.39			
220	HK Lac	209813	95.92	-6.72	-15.5	149.2	-17.7	-48.82	4.36	-29.02	0.61	-4.47	0.76	2	Hya	
221	AR Lac	210334	95.56	-8.30	-4.0	41.4	-6.1	4.82	0.13	-31.43	0.50	18.66	0.36			
222	δ Cap	207098	37.60	-46.01	6.5	5.0	-8.5	-7.46	0.38	-18.9	0.38	-9.75	0.64	2	LA	
223	KX peg	212280	88.56	-22.40	3.4	134.1	-55.3	20.00	3.17	6.13	0.46	5.86	1.12	1	Uma	
224	V350 Lac	213389	100.61	-7.29	-22.3	119.2	-15.5	17.11	1.48	8.31	0.37	-8.08	0.56			
225	FK Aqr	214479	37.82	-57.09	3.7	2.9	-7.3	-17.89	0.34	-10.29	0.24	-2.06	0.60	1, 1	Cas, IC	
226	IM Peg	216489	86.36	-37.48	4.9	76.7	-58.9	11.98	1.12	-15.54	0.34	4.64	0.37			
227	AZ Psc	217188	73.04	-51.93	26.5	87.0	-116.1	-44.42	5.08	-17.47	2.78	4.92	3.85	1	Hya	
228	TZ PsA	217344	10.62	-65.27	27.1	5.1	-59.8	13.38	0.86	-49.05	5.71	-38.67	1.50			
229	KU Peg	218153	95.03	-31.06	-14.1	160.1	-96.8	-36.56	6.56	-84.74	2.78	20.31	3.64			
230	KZ And	218738	105.90	-11.53	-6.8	23.8	-5.1	-14.68	3.17	-12.10	1.26	-4.01	1.25	1, 1	Cas, IC	
231	RT And		108.06	-6.93	-23.2	71.2	-9.1	2.92	0.57	1.52	0.58	-5.92	0.58	1	Uma	
232	SZ Psc	219113	80.67	-51.96	8.8	53.6	-69.5	-12.15	1.09	12.57	1.32	-6.87	1.61			
233	EZ Peg		97.59	-32.46	-14.4	108.3	-69.5	35.92	6.02	-5.10	2.97	34.70	3.38			
234	V368 Cep	220140	118.46	16.94	-9.0	16.6	5.8	-10.45	0.94	-23.48	1.69	-5.48	0.58	1	LA	
235	lam And	222107	109.90	-14.54	-8.5	23.5	-6.5	-1.60	0.08	-7.97	0.30	-54.97	0.94	1	Cas	
236	KT Peg	222317	104.23	-32.00	-10.3	40.6	-26.1	-85.67	3.20	-9.23	0.42	24.78	0.90			
237	II Peg	224085	108.23	-32.62	-11.2	33.9	-22.8	-99.63	3.92	-63.28	1.77	-9.31	0.77			

Table 4. Physical parameters of CABs.

ID	Name	HD	Spectral type	SB	P(days)	e	M_h/M_c	M_c	$f(M)$	R_h/R_c
1	BC Psc	28	K0IIIb	SB1	72.93	0.270		0.42-2.00	0.0300	/14.7
2	BD+45 4408	38	dK6	SB1						
3	5 Cet	352	K2III	SB1	96.40	0.040	0.79	1.40	0.1400	/39-42
4	LN Peg		G8V+K5V	SB1 in SB3	1.84	0.000			0.4000	0.76/
5	BD Cet	1833	K1III+F	SB1	35.10	0.040			0.1100	/14.0
6	13 Cet	3196	F8V+G4V	SB1	2.08	0.000	1.83	0.24	0.0189	/1.47
7	BK Psc		K5V+M4V	SB1	2.17	0.003	1.81	0.37		0.72/0.45
8	FF And		dM1e+dM1e	SB2	2.17	0.000	1.03	0.54		
9	zeta And	4502	K1III	SB1	17.77	0.000	0.29	2.70	0.0320	0.7/13.4
10	CF Tuc	5303	G0V+K4IV	SB2	2.80	0.000	0.88	1.20		1.5/4.6
11	eta And	5516	G8III/IV	SB2	115.72	0.060	1.11	2.34		11.0/11.0
12	BE Psc	6286	G2V	SB1	91.90					
13	CS Cet	6628	(G8-K1)III/IV+F	SB1	27.32	0.293	0.88	1.48	0.0780	/>3.8
14	AI Phe	6980	F7V+K0IV	SB2	24.59	0.190	0.97	1.24		1.82/2.93
15	YR 20	7205	G8V	SB1						
16	AY Cet	7672	WD+G5IIIe	SB1	56.82	0.000	0.26	2.09	0.0029	0.012/15
17	UV Psc	7700	G5V+K2V	SB2	0.86	0.000	1.31	0.76		1.11/0.83
18	BC Phe	8435	G7V/IV+K3V	SB2	0.66	0.000	0.78		0.0056	
19	BI Cet	8358	G6V/IV+G6V/IV	SB2	0.52	0.000	1.09	0.88		0.90/0.90
20	AR Psc	8357	K1IV+G7V	SB2	14.30	0.185	0.82	1.12		1.5/1.5
21	BF Psc	9313	G5V	SB1	53.50	0.390			0.0620	
22	BB Scl	9770	K3V+K5V	SB1 in SB3	0.48					0.72/0.74
23	UV For	10909	K0IV	SB1	30.11	0.499		1.50	0.0013	/4.6
24	XX Tri	12545	K0III	SB1	23.97	0.000	4.50	0.40	0.0110	/11.4
25	TZ Tri	13480	K0III+F5	SB2	14.73	0.040	0.98	2.58		/13.0
26	BQ Hyi	14643	G1:IVp	SB1	18.38	0.020			0.1300	
27	CC Eri	16157	K7.5V+M3.5V	SB2	1.56	0.050	1.86	0.31		0.645/0.41
28	UX For	17084	G6V+K0.5V	SB2	0.95	0.000	1.37		0.0770	0.98/0.83
29	VY Ari	17433	K0V	SB1	13.20	0.090			0.0420	/1.9
30	EP Eri	17925	K1V+K2V							
31	EL Eri	19754	G8III-IV	SB1	48.26	0.100	2.64	0.53	0.0240	/9.5
32	LX Per		G0V-IV+K0IV	SB2	8.04	0.000	0.93	1.32		1.64/3.05
33	V510 Per	19942	G5IV	SB1	45.78	0.000			0.0926	/3.0
34	BU 1178 AB	21018	G5III	SB1	287.20	0.000			0.0380	/10.0
35	UX Ari	21242	A2/3V+K1/2V	SB2	6.44	0.000	0.86	1.10		1.11/5.78
36	IX Per	22124	F2III-IV		1.33					
37	V711 Tau	22468	K1IV+G5IV	SB2	2.84	0.000	0.82	1.39		1.76/3.80
38	V837 Tau	22403	G2V+K5V	SB2	1.93	0.000	1.49	0.67	0.0943	1.0/0.74
39	V1082 Tau	22694	G5V	SB2	8.65	0.390	1.04			/1.0
40	BD+44 801	23838	G2III+F2V	SB1	962.80	0.720	1.17	1.28	0.2800	
41	V471 Tau		K2V+WD	SB1	0.52	0.000	0.97	0.76	0.1776	0.0097/0.83
42	AG Dor	26354	K0V+K4V	SB2	2.56	0.000	1.74		0.0470	0.86/0.51
43	EI Eri	26337	G5IV	SB1	1.95	0.000	2.64	0.53	0.0042	/>1.90
44	V818 Tau	27130	G6V+K6V	SB2	5.61	0.000	1.40	0.78		1.0/0.8
45	BD+17 703	27149	G2V+G8V	SB2	75.65	0.230	1.14	0.99		1.0/1.0
46	STT 82 AB	27691	G0V	SB1	4.00	0.060			0.0193	
47	V988Tau	284414	K2V	SB1	590.6	0.640			0.0272	
48	V918 Tau	28291	G8V	SB1	41.66	0.662			0.0007	/0.90
49	V492 Per	28591	G9III	SB1	21.29	0.000			0.0584	/>10.0
50	V833 Tau	283750	dKVe	SB1	1.79	0.000		0.80	0.0002	/>0.22
51	3 Cam	29317	K0III	SB1	121.00	0.020			0.2820	/12.8
52	RZ Eri	30050	F0IV+G5-8III	SB2	39.28	0.150	1.04	1.63		2.84/6.94
53	V808 Tau	283882	K3V+K3V	SB2	11.93	0.511	1.05	0.77		0.80/0.80
54	BD+64 487	30957	K2-3V+K5V	SB2	44.40	0.092	1.09	0.74		
55	V1198 Ori	31738	G5IV							/>1.50
56	BM Cam	32357	K0III	SB1	80.90	0.050	0.55	1.10	0.0650	/24.0
57	HP Aur	280603	G8V	SB2	1.42		1.19	<0.75		
58	YZ Men	34802	K1IIIp	SB1	19.31	0.000			0.1100	/4.0
59	alfa Aur	34029	G1III+K0III	SB2	104.02	0.002	0.95	2.61		8.7/12.8
60	CL Cam	33363	K0III	SB1	20.87	0.071			0.0044	/7.4

Table 4 – *continued*

ID	Name	HD	Spectral type	SB	P(days)	e	M_h/M_c	M_c	$f(M)$	R_h/R_c
61	BD+10 828	37171	K4III	SB1						
62	TW Lep	37847	F6IV+K2III	SB2	28.34	0.050	0.95	1.02		/11.5
63	V1149 Ori	37824	K1III+F5V	SB1	53.58	0.000			0.0900	/13.4
64	V1197 Ori	38099	K4III	SB1	143.04	0.000	0.79	0.90	0.0112	/51.3
65	TZ col	39576	G1V	SB1						/>1.07
66	SAO 234181	39937	F7IV							
67	SZ Pic	39917	K0IV-III+G3IV+III	SB2	4.96					
68	V403 Aur	39743	G8III	SB1	83.10	0.180			0.0035	/11.6
69	V1355 Ori	291095	K1IV+G2V	SB1	3.87	0.000		1.03	0.0231	1.0/3.5
70	CQ Aur	250810	G8IV+F5V	SB2	10.62	0.000	0.88	2.00		1.93/9.91
71	TY Pic	42504	G8/K0III+F	SB1	106.74	0.320			0.2650	/6.0
72	V1358 Ori	43989	G0IV+G0IV		3.63					/1.66
73	V1260 Ori	43930	K1V	SB1	111.69	0.120			0.0053	
74	OU Gem	45088	K2V+K5V	SB2	6.99	0.150	1.20	0.59		
75	TZ Pic	46697	K2IV/III	SB1	13.64	0.050			0.0059	/16.0
76	SV Cam	44982	F5V+K0V	SB2	0.59	0.000	1.55	0.70		1.18/0.76
77	VV Mon		G5V+G8IV	SB2	6.05	0.030	0.94	1.50		1.8/6.2
78	QY Aur		dM5e+dM5e	SB2	10.43	0.340	1.20	<0.16		
79	SS Cam		F5V-IV+K0IV-III	SB2	4.82	0.000	0.95	1.83		2.2/6.4
80	SAO 23511	57853	F9.5V+G0V	SB1	122.17	0.000	1.47	0.75		1.00/0.75
81	AR Mon	57364	K2III+G8III	SB2	21.21	0.000	3.27	0.80		14.2/10.8
82	YY Gem	60179C	dM1e+dM1e	SB2	0.81	0.000	1.08	0.57		0.60/0.60
83	V344 Pup	61245	K1IV-III	SB1	11.76	0.010			0.0660	/11.0
84	sigma Gem	62044	K1III	SB1	19.60	0.020		1.00-2.30	0.0875	/12.3
85	81 Gem	62721	K4III	SB1	1519.7	0.320				
86	BD+42 1790	65195	dF/G5III	SB1	37.90	0.000			0.2020	
87	AE Lyn	65626	F9IV-V+G5IV	SB2	11.07	0.125	1.02	1.61		3.14/2.64
88	LU Hya	71071	K1IV+G5V?	SB1	16.54	0.130			0.0021	/3.4
89	BD+28 1600	71028	K0III	SB1						
90	GK Hya		F8+G8IV	SB2	3.59	0.000	0.91	1.34		3.39/1.51
91	VX Pyx	72688	K0II+F6IV	SB1	45.13	0.000			0.0048	11.0/
92	RU Cnc		G8IV+F6-7	SB2	10.17	0.000	0.99	1.47		1.9/4.9
93	RZ Cnc	73343	K1III+K3/4III	SB2	21.64	0.000	5.88	0.54		10.20/12.20
94	TY Pyx	77137	G5V+G5-8V	SB2	3.20	0.000	1.01	1.20		1.58/1.86
95	WY Cnc		G0-8V+K2?	SB1	0.83	0.000	2.02	0.53		0.93/0.58
96	XY UMa	237786	G0V+K5V	SB1	0.48	0.000	1.65	0.66		0.63/1.16
97	BD+40 2194	80492	KIII	SB1	23.85	0.000		2.00	0.0063	
98	BF Lyn	80715	K2V+[dK]	SB2	3.80	0.000	1.03	0.74		>0.78/>0.78
99	IL Hya	81410	K1/2III/IV+G5V/IV	SB2	12.90	0.000	0.60	2.20	0.0960	/8.0
100	IN Vel	83442	K2IIIp	SB1	52.27	0.130			0.0480	
101	DY Leo	85091	F9V+K0V	SB1	3.39	0.002			0.0143	
102	DH Leo	86590	(K2V+K5V)+K5V	SB2 in SB3	1.07	0.000	1.48	0.58		0.97/0.67
103	XY Leo		M1V+M3V	SB2	0.81	0.000	1.40	0.35		
104	FG Uma	89546	G9III	SB1	21.36	0.000	2.59	0.58	0.0269	/9.1
105	DW Leo	90385	G8III	SB1	99.85	0.000			0.0300	
106	LR Hya	91816	K0/1V+K1/2V	SB2	6.87	0.014	1.00	0.54		0.8/0.8
107	UV Leo	92109	GOV+G2V	SB2	0.60	0.000	1.03	1.09		1.081/1.186
108	DM UMa		K0-1IV-IIIp	SB1	7.49	0.200			0.0110	/>3.80
109	BD+23 2297	95559	K1V+K1V	SB2	1.53		1.01	0.92		0.778/0.778
110	DS leo	95650	M0	SB2	1.53					
111	FK Uma		G1IV-V	SB1	6.57	0.004			0.0583	0.94/
112	ξ UMa B	98230	G5V	SB1 in SB3	3.98				0.0000	
113	SZ Crt	98712	K7V+M3V							
114	TV Crt	98800	K5V	SB4						
115	BD +36 2193		G6V	SB1	7.15	0.008			0.0819	/0.66
116	EE UMa	99967	K2III	SB1	74.87	0.024		1.22-1.94	0.1887	/27.80-33.60
117	V829 Cen	101309	G5V+K1IV	SB2	11.71	0.060	0.98	0.29		/5.50
118	GT Mus	101379J	K2-4III+(A0)	SB1	61.36	0.000	0.80	2.50		
119	RW UMa		F8IV+K0IV	SB2	7.33	0.000	1.05	1.49		2.31/4.24
120	DQ Leo	102509	G5IV-III+A6V	SB2	71.69	0.000	0.88	2.10		1.7/5.9

Table 4 – *continued*

ID	Name	HD	Spectral type	SB	P(days)	e	M_h/M_c	M_c	$f(M)$	R_h/R_c
121	HU Vir	106225	K0IV	SB1 in SB3	10.39	0.009			0.1027	/3.40
122	DK Dra	106677	K1III+K1III	SB2	64.47	0.000	1.02	1.72		14.0/14.0
123	AS Dra	107760	G4V+G9V	SB2	5.41	0.000	1.13	0.71		
124	IL Com	108102	F8V+F8V	SB2	0.96	0.000	1.04	0.82		1.10/1.10
125	HZ Com		G9+K4V	SB2	3.56	0.013	1.05	0.67		>0.85/>1.1
126	IM Vir	111487	G5V	SB1	1.31	0.000			0.1060	
127	IN Com	112313	G5III-IV	SB2 in SB3	1.99	0.000	3.64	>0.004		1.76/0.58
128	UX Com		K1IV+G2	SB2	3.64	0.000	0.86	1.20		1.0/2.5
129	IS Vir	113816	K2III	SB1	23.65	0.022	2.27	0.66	0.0007	/12.0
130	RS CVn	114519	F6IV+G8IV	SB2	4.80	0.000	0.96	1.44		1.99/4.00
131	SAO 240653	114630	G0V+G0V	SB2	4.23	0.000	1.00	1.09		
132	BL CVn	115781	K1II+FIV	SB2	18.69	0.000	1.01	1.33		3.0/15.2
133	BM CVn	116204	KIII	SB1	20.63	0.000			0.0034	/15.0
134	BD+36 2368	116378	G5V	SB1	17.76	0.120			0.0057	
135	IN Vir	116544	K2-3IV	SB1	8.19	0.000			0.0970	/2.90-4.30
136	BH CVn	118216	F2IV+K2IV	SB2	2.61	0.000	1.84	0.80		3.1/3.27
137	IT Com	118234	K1III	SB1	59.05	0.590				/7.0
138	V764 Cen	118238	K2IIIp	SB1	22.74	0.000			0.0075	
139	BD+02 2705	118981	F9V+K0V	SB1	14.50	0.480			0.0448	
140	V851 Cen	119285	K3V-IV	SB1	11.99	0.000			0.0012	/2.3
141	BH Vir	121909	F8V-IV+G2V	SB2	0.82	0.000	0.98	1.02		1.25/1.114
142	FR Boo	122767	K0III	SB1	1189.18	0.870			0.0158	/15.2
143	4 Umi	124547	K3III	SB1	605.80	0.140			0.1240	
144	V841 Cen	127535	K1IV	SB1	6.02	0.000			0.0250	/1.10-2.00
145	RV Lib	128171	G8IV-K3IV	SB2	10.72	0.014	5.48	0.43		/6.8
146	37 Boo	131156	G8V+K5V		10.47					
147	DE Boo	131511	K1V	SB1	125.37	0.510			0.0610	/0.8
148	SS Boo		G0V+K0IV	SB2	7.61	0.000	0.99	0.97		1.3/3.3
149	UV CrB	136901	K2III	SB1	18.67	0.045	2.76	0.39	0.0206	/20.3
150	GX Lib	136905	K1IV-III	SB1	11.13	0.000		0.60-1.00	0.0672	/8.0
151	LS TrA	137164	K2IV+K2IV	SB2	49.43	0.516	0.99		2.8900	
152	UZ Lib		K0III+A8?	SB1	4.77	0.050	0.31	1.10	0.0182	1.0/21.0
153	RT CrB	139588	G2IV	SB2	5.12	0.000	0.99	1.42		2.6/3.0
154	QX Ser	141690	(G2IV-V)+G5-8V	SB4	4.67	0.050			0.0200	
155	RS UMi		G0V+G-KV	SB2	6.17	0.000	1.02	1.23		
156	MS Ser	143313	K2IV+G8V	SB2	9.01	0.000	1.21	0.71		1.0/3.5
157	NQ Ser	144515	G8IV	SB1	4.29	0.031			0.0480	
158	TZ CrB	146361	F6V+G0V	SB2	1.14	0.000	1.03	1.08		1.14/1.10
159	V846 Her	148405	G6III	SB1	52.45					/7.9
160	CM Dra		M4V+M4V	SB2	1.27	0.005	1.08	0.21		0.25/0.23
161	BD-03 3968	149414	G5V	SB2	133.29	0.281	1.76	0.40-0.50		
162	WW Dra	150708	G2IV+K0IV	SB2	4.63	0.000	1.01	1.34		2.12/3.90
163	epsilon UMi	153751	G5III+A8-F0V	SB1	39.48	0.040	0.46	2.80		1.7/12.0
164	V2253 Oph	152178	K0III	SB1	314.47	0.024			0.0959	/16.2
165	V792 Her	155638	F3V+K0III	SB2	27.54	0.000	0.96	1.47		2.58/12.28
166	V832 Her	155989	G5III	SB1	122.56	0.318			0.0880	
167	V824 Ara	155555	G7IV/V+K0IV/V	SB2	1.68	0.000	1.10	1.01		1.55/1.42
168	V819 Her	157482	(F2V+F8V)+G8IV-III	SB2 in SB3	2.23	0.000	1.42	1.15		1.87/1.29
169	V965 Sco	158393	F2IV+K1III	SB2	30.97	0.000	1.01	1.70		5.5/14.0
170	DR Dra	160538	K2III+WD	SB1	903.8	0.072			0.0035	0.012/8.0
171	V834 Her	160952	G8III	SB1	181.70	0.380			0.0003	
172	BD+44 2760	161570	G7III/GV	SB1	45.62	0.008	1.20	1.25	0.0615	/10.3
173	V826 Her	161832	K3III-II	SB1	99.56	0.000		0.57-2.32	0.0454	/25.0
174	V835 Her	163621	G8V+K7V	SB2	3.30	0.000	1.43	0.59		0.9/0.6
175	Z Her	163930	K0IV+F5	SB2	3.99	0.000	1.19	1.31		1.85/2.73
176	MM Her	341475	G2IV+K1V	SB2	7.96	0.040	0.94	1.27		1.56/2.89
177	V772 Her	165590	(G0V+?)+K7V	SB2 in SB5	0.88	0.045	1.76	0.59		0.90/.58
178	ADS 11060C	165590C	K7V	SB2 in SB5	25.76	0.565	1.05	0.51		0.6/
179	V832 Ara	165141	G8III+WD	SB1	5200.00	0.180			0.0300	/15.0
180	V815 Her	166181	G5V+M1-2	SB1	1.81	0.029			0.0306	>0.97/

Table 4 – *continued*

ID	Name	HD	Spectral type	SB	P(days)	e	M_h/M_c	M_c	$f(M)$	R_h/R_c
181	PW Her		K0IV+F8-G2	SB2	2.88	0.000	0.77	1.50		1.4/3.8
182	AW Her	348635	G2IV+K2IV	SB2	8.80	0.000	0.91	1.33		2.4/3.2
183	BY Dra	234677	K6Ve + K7V	SB2	5.98	0.307	1.12	0.44		1.20-1.40/
184	Omi Dra	175306	G9III	SB1	138.42	0.114			0.1830	/>37.00
185	35 Sqr	175190	K3III	SB1						
186	V1285 Aql		dM2e+dMe	SB2	10.32	0.200	1.07	0.30		0.44/0.44
187	V775 Her	175742	K0Ve+dM3e	SB1	2.88	0.003			0.0362	/0.9
188	Tau Sqr	177716	K1III	SB1						
189	V478 Lyr	178450	G8V+dK-M	SB1	2.13	0.000	3.72	0.25	0.0118	/0.98/0.30
190	V1762 Cyg	179094	K2IV-III+G8V	SB2	28.59	0.000	0.89	1.49	0.1939	0.9/6.2
191	26 Aql	181391	G8III-IV	SB1	266.54	0.830			0.1280	/3.8
192	V1430 Aql		G5V+K0III-IV	SB2	0.87		1.04	0.90	0.1400	0.86/1.11
193	V4138 Sgr	181809	K1III	SB1	13.05	0.050			0.0008	/12.0
194	V4139 Sqr	182776	K2-3III	SB1	45.18	0.020			0.1700	/16.0
195	V1817 Cyg	184398	K2III-II+A0V	SB1	108.85	0.050	0.60	4.83	0.1222	/62.0
196	V1764 Cyg	185151	K0III	SB1	40.14	0.000		1.23-1.76	0.2870	/25.0
197	V1379 Aql	185510	K0III+sdB	SB1	20.66	0.094	0.13	2.70	0.0042	/>7.5
198	V4200 Ser	188088	K2-3V+K2-3V	SB2	46.82	0.692	1.00	0.85		$\sim$ 0.80/ $\sim$ 0.80
199	V4091 Sqr	190540	K0III	SB1	16.89	0.040			0.0450	/12.0
200	BD+15 4053	191179	K0IV+G2V	SB2						1.0/1.9
201	V1423 Aql	191262	G5V+G5V	SB2	5.43	0.000	1.00	1.02		
202	V1971 Cyg	193891	K0III	SB1	38.79	0.022			0.0840	/>9.0-10.0
203	AT Cap	195040	K2III	SB1	23.21	0.050			0.0610	/16.0
204	MR Del	195434	K0V		0.52					
205	CG Cyg		G9+K2	SB2	0.63	0.000	1.16	0.81		0.88/0.87
206	V1396 Cyg		M2V+M4Ve	SB2	3.28	0.000	1.44	0.27		/0.40
207	ER Vul	200391	G0V+G5V	SB2	0.70	0.000	1.05	1.05		1.11/1.08
208	BN Mic	202134	K1IIIp	SB1	63.09	0.520			0.1300	/12.0
209	BU 163	202908	(F9V/G0V)+?	SB2 in SB3	3.97	0.003	1.06	1.08		
210	BD+39 4529	203454	F8V+K5V	SB2	3.24	0.000	1.77	0.66		1.10/0.74
211	BH Ind	204128	K1IIICNVp	SB1	22.35	0.120			0.0060	
212	HZ Aqr		K3Ve+K7Ve	SB2	3.76	0.000	1.24	0.55	0.8000	0.55/0.45
213	AS Cap	205249	K1III	SB1	49.14	0.080			0.0500	/13.0
214	AD Cap	206046	G5-8IV-V+G5	SB2	2.96	0.000	1.90	0.56		/3.3
215	42 Cap	206301	G2IV+G2V	SB2	13.17	0.177	1.37	1.00	0.0160	2.58/
216	V2075 Cyg	208472	G8III	SB1	22.62	0.000				/8.3
217	Gl 841A		dM3-5e	SB2	1.12	0.000	1.09	0.24	0.0056	0.36/0.34
218	FF Aqr		G8III-IV+sdOB	SB1	9.21	0.000	0.24	2.50		0.15/6.0
219	RT Lac	209318	G5V+G9IV	SB2	5.07	0.000	2.47	0.60		4.41/4.81
220	HK Lac	209813	K0III+F1V	SB1	24.43	0.010			0.1050	/12.0
221	AR Lac	210334	G2IV+K0IV	SB2	1.98	0.000	0.89	1.26		1.52/2.72
222	δ Cap	207098	F1IV-III/K1V	SB1	1.02	0.000	2.74	0.73	0.0450	1.91/
223	KX peg	212280	F5-8V+G8IV	SB2	45.28	0.499	0.82	1.70		/4.8
224	V350 Lac	213389	K2IV-III	SB1	17.75	0.200	1.22	0.90		/12.0
225	FK Aqr	214479	dM2e+dM3e	SB2	4.08	0.010	1.24	>0.22		
226	IM Peg	216489	K2III-II	SB1	24.65	0.006	0.53	1.50	0.1042	/13.3
227	AZ Psc	217188	K0III	SB1	47.12	0.500			0.0041	/12.0
228	TZ PsA	217344	G5V+K3V	SB2	1.64	0.000	1.28		0.0540	1.0/0.8
229	KU Peg	218153	K0II-III+G9	SB1	1411.00	0.390		2.30	0.0018	/18.0
230	KZ And	218738	dK2+dK2V	SB2	3.03	0.034	1.05	0.63		/>0.74
231	RT And		F8V+K0V	SB2	0.63	0.026	1.35	0.91		1.26/0.92
232	SZ Psc	219113	K1IV+F8IV	SB2	3.97	0.000	0.77	1.62		1.5/5.10
233	EZ Peg		G5IV+K0IV	SB2	11.66	0.000	0.99	0.93		
234	V368 Cep	220140	G5V	SB1						
235	lam And	222107	G8IV-III	SB1	20.52	0.040		0.65	0.0006	/7.5
236	KT Peg	222317	G2V+K5V	SB2	6.20	0.000	1.49	0.62		1.0/0.6
237	II Peg	224085	K2IV+M0/3V	SB1	6.72	0.000	2.00	0.40	0.0403	/3.1